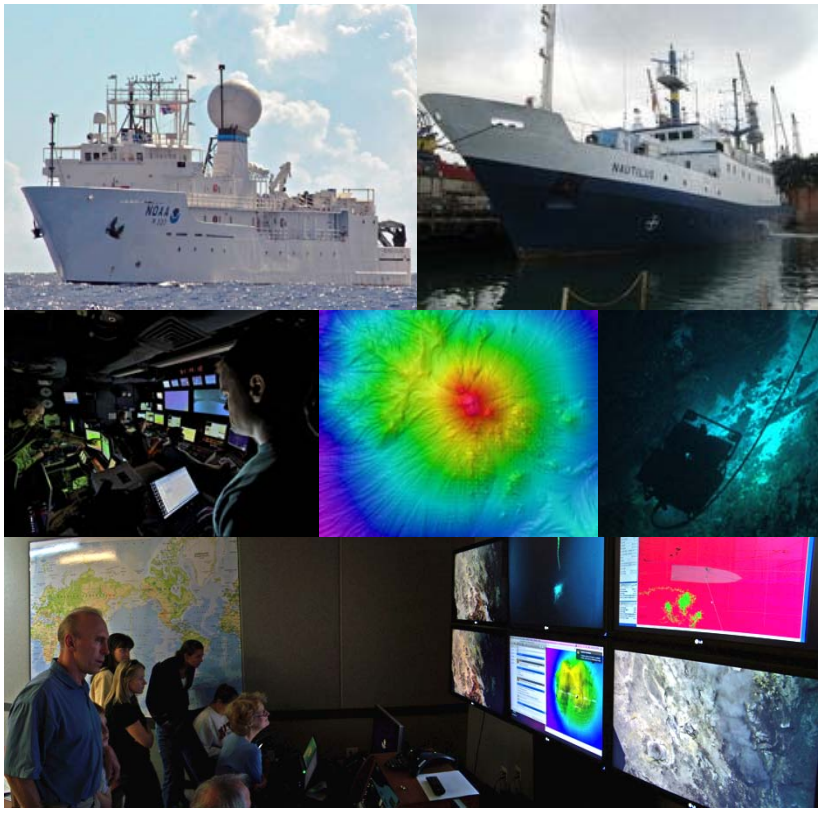
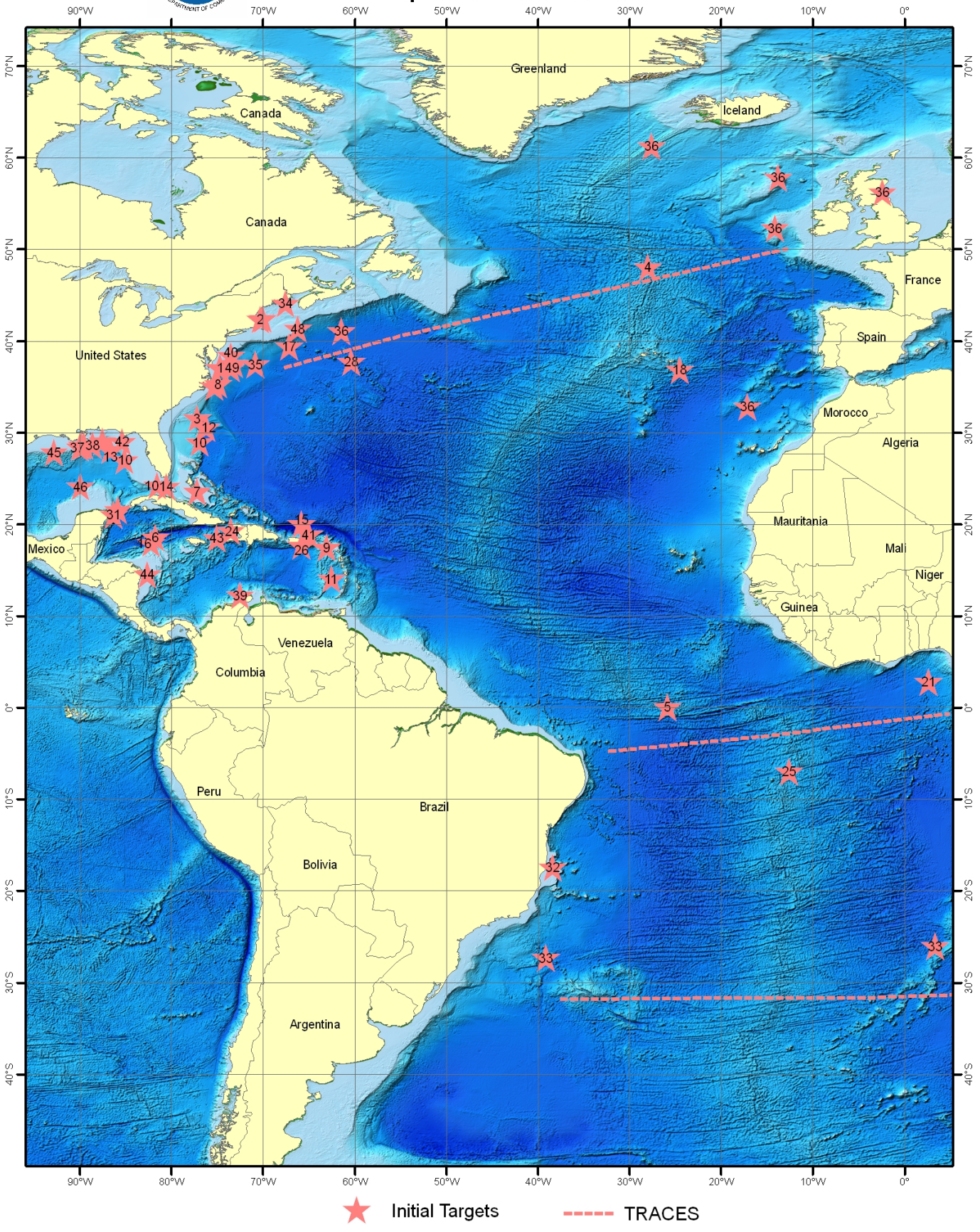
Pre-Workshop Target Recommendations

for Telepresence-Enabled Expeditions in the Atlantic Basin

April 18, 2011



NOAA Office of Ocean Exploration and Research
Workshop to Plan "Telepresence-Enabled" Expeditions for the Atlantic



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South Atlantic Region

Target Name : Gulf of Guinea

Why this area may be of interest

Biology - New hydrocarbon seep communities within a key biogeographic region.
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Chuck Fisher
Penn State University
cfisher@psu.edu
814-863-3365

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-**Yes**
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-**Yes**

Brief Overview of Area

The Gulf of Guinea and the Angola Basin are areas of active hydrocarbon exploration and extraction. There are numerous natural hydrocarbon seeps and expulsion features (mud volcanoes) in the area. Several cold seep and pockmark sites within the Angola Basin have been mapped by French cruises, including Guiness, Diapir, Kouliou, and Regab. The last three lie within the deep-sea fan of an underwater canyon that extends 750 km offshore, reaching a depth of 5000 m. The canyon is directly connected to the Congo River, which supplies a continuous stream of terrestrial organic material to Diapir, Kouliou, and Regab.

Brief Summary of what is known

The Guiness, Kouliou, and Regab pockmarks in the southern Gulf of Guinea have been surveyed by the French and the distribution of the foundation species of chemosynthetic fauna has been mapped. They include vesicomyid clams, bathymodiolin mussels, and siboglinid tubeworms. Sediment core samples were taken for distribution and abundance of the meiofauna. During the most recent French cruise, high resolution mosaics and one quantitative tubeworm community collection were made at Regab. This community shows some similarity to the cold seeps of the western Atlantic and Gulf of Mexico, but the larger ecology of the region remains unknown.

Rational for Exploration

The African Margin lies in the furthest east of the Atlantic Equatorial Belt region that was targeted as a key area for exploration and studies of connectivity in the Census of Marine Life ChEss program. While studies of the Angola Margin seeps have been led by the French and are still ongoing, the seeps of the Nigerian margin are not well described. On a recent hydrocarbon exploration cruise, a few box cores containing symbiotic seep fauna were obtained, but this location has not been visually surveyed.

Target Name : South Atlantic Ocean (trans-Atlantic) Vulnerable, Complex, Benthic Ecosystems

Why this area may be of interest

Biology - Actually all of these categories except archaelology apply to this proposal.
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Drs. Steve, J. Murray, Sandra Ross, Roberts, Brooke
Univ. NC at Wilmington, Heriot-Watt Univ., Marine Conservation Biology Inst.
rosss@uncw.edu
910-962-2346

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-**Yes**	South.Mid-Atlan.-**Yes**	East. South Atlan.-**Yes**

Brief Overview of Area

The offshore seamounts and banks of the North Atlantic are now known to support rich and complex deep-sea structural habitats of cold-water corals and sponges. Research over the last decade on deep-sea corals has grown exponentially as European and North American projects have explored these previously poorly-known areas. However, similar regions in the South Atlantic remain very poorly explored or are completely unexplored. This greatly limits the scientific community's understanding of deep-sea Atlantic habitat and faunal connectivity. We propose to carry out pioneering exploratory mapping and characterization within the following candidate regions in the South Atlantic Ocean. In the Southwestern Atlantic the target areas are the Campos and Santos Basins (Brazil), the Vitoria-Trindade Seamounts and the Rio Grande Rise. In the Southeastern Atlantic the target areas are the Walvis Ridge, potentially extending to the Islands of Tristan da Cuhna (a British Overseas Territory). Exploration of these areas would add substantially to our knowledge of complex benthic habitats in the Atlantic Basin and allow for important comparisons with the North Atlantic Ocean that are currently not possible.

Brief Summary of what is known

The South Atlantic Ocean is a region of high cold-water coral (CWC) species richness with at least 56 azooxanthellate scleractinian corals alone. The region supports CWC ecosystems such as coral carbonate mounds (Campos and Santos Basins), seamounts (the Vitoria-Trindade seamount chain) and ridges (the mid-Atlantic Ridge). In the Campos Basin on the Brazilian continental margin some of these sites have been initially (but not extensively) characterised. Here, coral carbonate mounds rise about 30-70 m high and cover an area up to 600 km2, having grown periodically since the last glacial and during cold deglacial stadials. The mounds and adjacent areas are bathed by waters that stratify key water masses such as Antarctic Intermediate Water and North Atlantic Deep Water. The archipelago of islands forming the Vitoria-Trindade seamount chain also hosts a high diversity of CWCs as well as deep-sea sponges, many of which are new to science. Using NOAA exploration time, we will focus on the partially mapped mound and unsurveyed seamount sites to explore this rich area for currently unknown coral, sponge, and other habitats.

Rational for Exploration

One of the foundation concepts of the Trans-Atlantic Coral Ecosystem Study (TRACES, see http://www.lophelia.org/traces) is to conduct standardized sampling across an ocean basin scale region in order to resolve scientific objectives and hypotheses that are of common interest throughout the North Atlantic Ocean. TRACES is focused on cold-water corals because they are a not only important ecologically but because they are emerging as a key palaeoceanographic water mass archive. By mapping and sampling in the South Atlantic Ocean we hope to discover and sample key areas where we can develop novel intermediate water mass histories to inform current palaeoceanographic research. Alongside coral habitats, other major features (submarine canyons, rocky reefs, sponge beds) share the TRACES concept and are good candidates for a basin wide approach. Comparisons of faunal community structure and habitat utilization for the same and different species at an ocean basin scale will facilitate understanding the ecosystem drivers. Although scientists throughout the Atlantic have common interest in the above deep-water habitats and have made major contributions to our understanding of such habitats, progress has been slowed by a lack of synoptic and standardized sampling. For example, the fish communities of cold-water coral habitats have been described for the northeastern Atlantic and off the southeastern US, but these data sets are not quantitatively comparable. Very large observed differences in how these fishes use the habitats in different regions cannot be well explained. Exploitation of continental margins is accelerating, and very often data are lacking to evaluate the impacts of such expansions. Increased knowledge about habitat types and extent of coverage and faunal associations will greatly improve the ability to manage these resources and will provide information necessary for large scale planning of Marine Protected Areas or other managed areas. More insidious impacts from climate change and ocean acidification also threaten Atlantic margin ecosystems, but without baseline data such potential impacts cannot be addressed. If developed, this proposal for South Atlantic exploration expands upon the study areas within the UK-TRACES project proposal to the British Natural Environment Research Council (total project budget £3.7m with two SW Atlantic cruises).

Objectives:

- Produce detailed multibeam sonar bathymetry and habitat maps (combining video data) of selected target study sites across the South Atlantic Ocean.
- Conduct standardized underwater ROV video transects across selected trans-Atlantic sites.
- Collect additional benthic and water column physical data (CTD, aragonite saturation, dissolved oxygen) to correlate with video observations.
- Provide data in real time to multi-disciplinary collaborators in participating countries.
- Conduct real time education and outreach via participating collaborators (e.g., NC Museum of Natural Sciences) and NOAA OER in the USA and Dynamic Earth in Edinburgh, UK).

Target Name : Brazil Deep Reef Discovery Project

Why this area may be of interest

Biology - Characterization of Deep-water Coral Ecosystems
Geology - Mapping and Characterization of Geological Features
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. M. Dennis Hanisak
Harbor Branch Oceanographic Institute at Florida Atlantic University
dhanisak@hboi.fau.edu
772-242-2306

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-**Yes**	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Deep-water communities off the coast of Brazil have been little studied compared to those of the North Atlantic. There are many areas of interest in this region of the South Atlantic. We propose to initially focus on the outer shelf and upper slope near Abrolhos Bank, a widening of the continental shelf of about 40,000 km2, in southern Bahia and northern Espirito Santo. This vast and relatively shallow area includes some of the most important marine ecosystems of Brazil, with some of the richest biodiversity in the South Atlantic and one of the most productive fisheries in the region (Leão & Kikuchi 2001, Dutra et al. 2006) and several marine endangered species (Moura 2002) . The Abrolhos Shelf and the extension of the adjacent continental shelf on the north, Royal Bank Charlotte, are classified as an "Area of Extreme Biological Importance" by the Brazilian Ministry of Environment (MMA 2002).

Brief Summary of what is known

Recent studies on the Abrolhos Shelf indicate a distribution of reef formations much broader than previously known. Surveys have identified a number of deep-sea coral hotspots for the South Atlantic (Sumida et al. 2004, Passeri Lavrado 2006, Pires 2007). The Brazilian deep-water coral banks, which have yet to be systematically explored, can reach hundreds of m in length, tens of m in width, 10 to 15 m in height and are characterized by a 40-km long coral field found at depths of 570-850 m (Viana et al. 1998). The REVIZEE program sampled the two major corals that form these reefs (Lophelia pertusa and Madrepore oculata) at 17° 25 'S, 038° 22' W, 450 m in depth. Recently, CENPES/Petrobras in collaboration with the National Museum/UFRJ initiated a study on the reproductive cycle of four species of deep-water corals (ca. 900 m deep) of the Bacia de Campos (Deborah Pires); they were the first collections specifically for biological studies of Brazilian deep water corals made by ROV and studied monthly for 13 months.

Rational for Exploration

Florida Atlantic University (FAU) and the University of Miami (UM) have begun working with CEPEMAR Environmental Services and a consortium of Brazilian scientists lead by Dr. Rodrigo Leao de Moura (State University of Santa Cruz & Conservation International - Brazil, Marine Program) to utilize a suite of ocean exploration tools to explore little known, but ecologically important, sites off the coast of Brazil. Our goal is to develop a 5-year plan of exploration and study that will not only contribute to a better characterization of Brazil's marine coral reef resources but also lead to a plan for their management and conservation. This new OER opportunity for systematic exploration of the Atlantic provides a means to map and characterize geological features in the outer reef platform and upper slope and the distribution of benthic reef communities.

We have begun to discuss this effort with three Brazilian university partners: University of Espirito Santo, University of Sao Paolo and Federal University of Rio de Janeiro. The group also includes two NOAA Cooperative Institutes, which are headed by FAU (CIOERT) and the University of Miami (CIMAS). These institutes and their partners bring a complete range of ocean exploration and analysis tools that can be used in partnership with the strong Brazilian government laboratories like INPE, which are already long experienced in much of this work. The core institutions also include the Georgia Aquarium, which has a unique history of interpreting marine and oceanic wonders to general and professional audiences, and the international non-governmental organization, Conservation International, which brings communication and policy capabilities. HBOI-FAU's Johnson-Sea-Link II, a 1000-m capable research submersible, is currently based in Brazil and is available to follow-up the systematic surveys proposed herein.

Benefits (including the 5-year study):

- Improved characterization of reefs and the seabed on Brazil's continental shelf and upper slope regions
- Enormous potential for discovery of new species and novel relationships, especially given how little is known about the mesophotic and deep-reef habitats in this region of the western Atlantic
- Assessments of coral reef health, coral disease and stressors (man-made and natural) and biodiversity necessary for conservation and protection of reef habitat
- Establishment of a baseline that can be used to establish hypotheses for research on, and mitigation of, ocean acidification, the effects of which are likely to be specific to different regions of the ocean
- Development of decision-support tools for current and new marine protected areas
- Discovery of novel chemicals from benthic organisms and microbes to study, diagnose, and/or treat human diseases
- Education and outreach: discoveries and science reported real-time on @sea webpages, @sea and post-cruise training of students, publications of research in peer-reviewed science journals and articles on discoveries in general interest publications, and presentations

Target Name : The Georgia Bight Outer Continental Shelf

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology - X
Other -

Contact Information

Dr. Ervan Garrison (Jessica Cook Hale, co-PI)
University of Georgia
egarriso@uga.edu, jcook@uga.edu
706-542-1097

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-**Yes**	East. South Atlan.-

Brief Overview of Area

The proposed area for study is the geographic province within the South Atlantic Bight (SAB) known as the Georgia Bight. It is best described as an embayment portion of a passive continental margin characterized by a thin sedimentary layer overlying a Cenozoic geology made up of extensive yet condensed sections that have resulted from paleo-oceanographic processes. This embayment is mildly up-warped on the north by the Cape Fear Arch at latitude 33 degrees, 30 minutes North; it is down-warped south of this latitude until in the south, at 30 degrees North, this margin rises again with the Florida carbonate platform. Active fault systems are few, with the Charleston Fault being the most prominent. The present-day sea floor existed for millennia as a subaerial coastal plain that pre-and-post Last Glacial Maximum (LGM) was populated by Rancholabrean fauna and colonized by prehistoric human groups.

Brief Summary of what is known

The Georgia Bight continental shelf is dominated by sediments, unconsolidated and consolidated, that are eroded relicts of earlier subaerial coastal landforms characterized by dunes, wetlands, coastal rivers,and forests much like today yet clearly non-analog in character. The proximal cause of the erosion of these coastal landforms is sea level change. Outcrops and hard bottoms are interspersed with large coextensive areas of sand. The Georgia Bight, like the Middle Atlantic Bight (MAB), is incised with coastal plain rivers. These paleo-channels are incised into Pliocene–Miocene geologic strata, creating paleo-valleys that have subsequently backfilled during sea level changes. In regard to relative sea level (RSL), the research done by the PI, USGS, Coastal Carolina University and the College of Charleston has shown the surface of the Georgia Bight has numerous, along strike, ledges which suggest evidence of sea level stillstands which were prehistoric shorelines. In our site models we postulate a higher probability for intact prehistoric sites to be located near these now drwowned shorelines and in paleo-valleys and river channels as opposed to the more readily eroded uplands and coastal plains. To date, diver and submersible surveys, conducted by UGA and NOAA, have yielded three archaeological (Archaic Period) artifacts together with numerous paleontological finds to include mammoth, bison, horse. In 2006, a nearly intact left mandible of a 36,000 year old Atlantic gray whale, now extinct in the Atlantic Basin, was successfully excavated in 20 meter water depths. This specimen is being cast at the Smithsonian Institution.

Geophysical,sedimentological and palynological data, collected in cores, have been analyzed and published. A more complete picture of the paleoecology of a subaerial coastal plain-Pleistocene shoreline has emerged based on these studies. However, these studies have only addressed fewer than a half-dozen sites located along the 20 meter isobath; the wider regional picture still has many lacunae due in large part to our inability to accomplish detailed mapping at a geographic mesoscale.

Rational for Exploration

Throughout the Pleistocene, 2.6 my to the Holocene (10 ky), the Georgia Bight was alternately a subaerial plain and a shallow ocean. During long, multi-millennial periods of subaerial exposure this coastal plain was a rich biome which present day research has only begun to adequately characterize. As noted above, diver and submersible survey, along with coring/sediment sampling, have been carried out by the PI Garrison and co-workers since 1996. However, these are time-consuming methods that cannot address regional-scale questions. Given the limitations of diver and submersible survey in our research, it is simply not possible to address the wider geological, paleontological, and archaeological context of the Georgia Bight. High resolution telepresence data taken for the region will provide this context and allow for the creation of a synthetic overview of it. This will provide the baseline from which targeted geological, paleontological, and archaeological research can proceed. Specific areas within the Georgia Bight can then be better identified as optimal sites for in-depth investigation of geological, paleontological, and archaeological questions, allowing us to better utilize diver and submersible surveys, and coring/sediment data collection.

Target Name : Non-Hydrothermal Fauna of the Ascension Fracture Zone (AFZ).

Why this area may be of interest

Biology - A totally unexplored area, perhaps comparable with the Charlie-Gibbs Fracture Zone
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Michael Vecchione
NMFS National Systematics Lab, National Museum of Natural History
vecchiom@si.edu
202-633-1751

Willing to attend? No

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-**Yes**	East. South Atlan.-

Brief Overview of Area

This is a major transverse fracture zone of the southern part of the Mid-Atlantic Ridge, where the ridge is offset by >230 km. It is located near 7 deg S latitude and covers almost 1/3 of the width of the basin. It is approximately coincident with the Atlantic Equatorial Upwelling region. It has steep topography and a wide valley filled with thick sediments.

Brief Summary of what is known

Geology and geophysics of the area have been studied in some detail. However, almost no biological information exists. Hydrothermal vents have been investigated on the ridge south of the AFZ. A single station targeting non-hydrothermal communities (hydrography, zooplankton/micronekton, and bottom trawling) was occupied near the Ascension Fracture Zone during a 2009 Brazilian/Russian expedition. The MAR-ECO project of the Census of Marine Life (CoML) has generated much biological information about the Charlie-Gibbs Fracture Zone (CGFZ) in the northern Mid-Atlantic Ridge. CGFZ, which is approximately coincident with the subpolar front, is is a dynamic area of benthic and pelagic biodiversity and biological activity and has now been partially protected as a high-seas MPA. AFZ, approximately coincident with the Equatorial Upwelling region, may be of similar potential importance.

Rational for Exploration

I suggest that a major OE expedition target the AFZ (similarly to ROV and manned-submersible exploration of the CGFZ by Norwegian, British and US/Russian expeditions). This would require detailed multibeam mapping of potential dive locations at a variety of depths, followed by dives primarily targeting epibenthic and demersal megafauna. An international South Atlantic equivalent of the MAR-ECO project has begun, but with limited commitment of resources to date. An exploratory expedition by OE would contribute to the South Atlantic MAR-ECO and to the planned continuation of CoML, tentatively referred to as Census 2020.

North Atlantic Region

Target Name : Crossroads of Maritime New England-Historic Shipwreck Investigations in the Stellwagen Bank National Marine Sanctuary

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology - Numerous unexplored historic shipwrecks with the potential for the discovery of a vessel dating from the colonial period.
Other -

Contact Information

Mr. Matthew Lawrence
Stellwagen Bank National Marine Sanctuary
Matthew.Lawrence@noaa.gov
781-545-8026 x213

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Stellwagen Bank National Marine Sanctuary sits astride historic shipping routes and fishing grounds used by mariners for the past 400 years (see Figure 1). The North Atlantic's stormy weather, human error, and the sheer volume of maritime traffic that has passed through the sanctuary over the past centuries have resulted in the reported loss of over 500 vessels in the sanctuary's vicinity. Previously investigated historic shipwrecks have been remarkably intact with numerous extant artifacts. Sanctuary regulations afford a much higher level of protection to underwater cultural heritage than is found in other Federal waters. Shipwrecks and other archaeological sites cannot be damage or disturbed under penalty of law. Furthermore, the sanctuary has a comprehensive management plan for the preservation and interpretation of its maritime heritage.

Brief Summary of what is known

Supported by FY2010 OER grant funding, Stellwagen Bank sanctuary archaeologists undertook a high-resolution synthetic aperture sonar survey in the northwest corner of Stellwagen Bank sanctuary on the approaches to the historic ports of Gloucester, Salem, Marblehead, and Boston (See Figure 2). The survey mapped 169 square-km of seafloor at a resolution of 3 cm-squared and located a dozen sonar targets with historic shipwreck characteristics. The sonar targets lie at depth from 60 m to 80 m. None of the targets have been further investigated to determine site characteristics. While sonar information cannot conclusively date a shipwreck, several of the sonar targets have characteristics of small wooden-hulled sailing vessels utilized over 200 years ago (See Figure 3). Past sanctuary expeditions have shown that much can be learned from visual inspection and limited sampling of sanctuary shipwrecks, due to limited sedimentation in the area.

Rational for Exploration

Investigating the previously located sonar targets has the potential to reveal significant information about maritime America over the past centuries. In particular, opportunities to explore vessels that may date from the Colonial Period are relatively rare. The remains of these oldest Euro-American vessels are difficult to locate and it was only through the application of advanced synthetic aperture sonar technology that the sanctuary has potential targets to investigate. Stellwagen Bank sanctuary shipwrecks that have sunk in deep water offer an opportunity to investigate vessels actively engaged in maritime activity with a full complement of material culture.

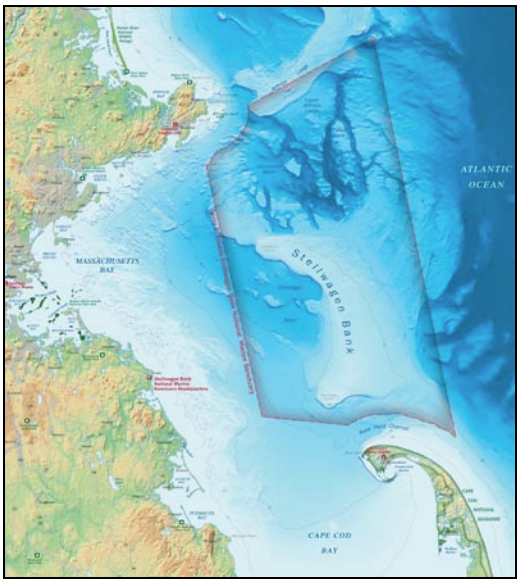


Figure 1. Stellwagen Bank National Marine Sanctuary and its Environs.

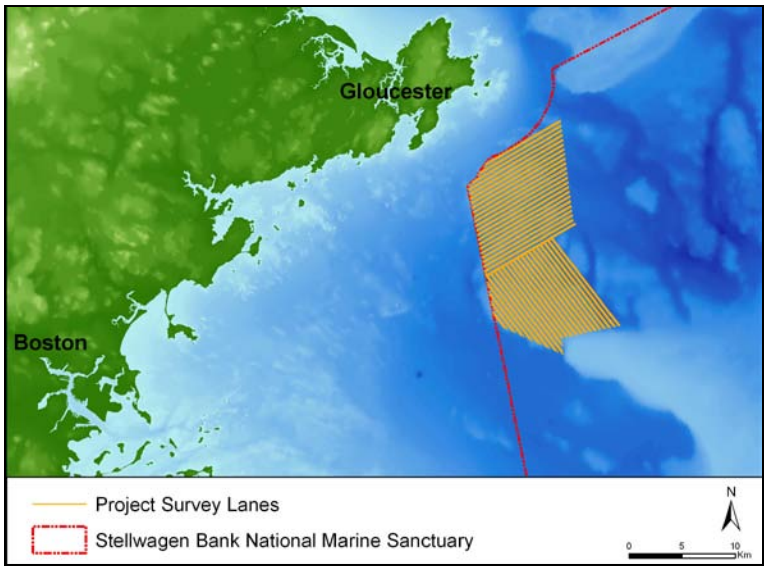


Figure 2. Synthetic Aperture Sonar Survey Area.

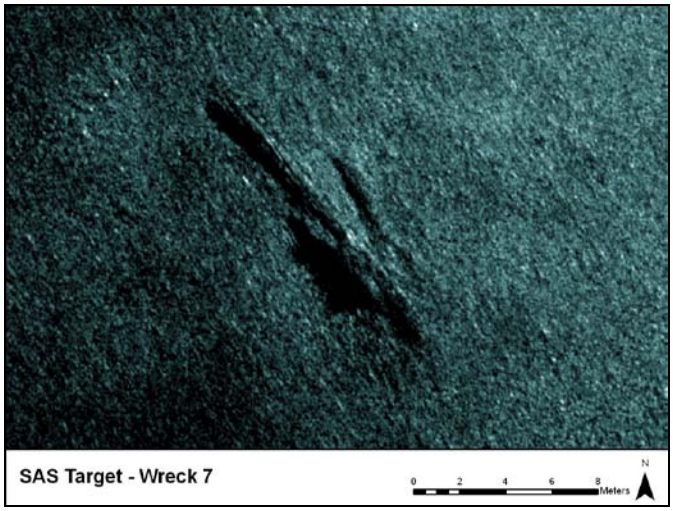


Figure 3. An Unexplored Synthetic Aperture Sonar Target.

Target Name : Bahama Banks (Great and Little Bahama Banks)

Why this area may be of interest

Biology - Extent and diversity of MCE communities; refugio of shallow corals to replenish degraded shallow reefs.
Geology - Variations in coral constructed submarine topography related to ocean conditions
Chemical Oceanography - Extent of syndepositional cementation of ocean-facing wall
Physical Oceanography -
Marine Archaeology - Human artifacts during sea level lowstands.
Other - A major source of fish and shellfish

Contact Information

Dr. Robert Ginsburg
Ocean Research and Education Foundartion Inc.
rginsburg@rsmas.miami.edu
(305) 421-5875

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Bahama Banks are an extensive archipelago of shallow (<10 m deep) flat-topped steep-sided carbonate platforms surrounded by oceanic depths. The total linear extent of Bahamian steep platform walls, one habitat for the MCE community, is some 5,300 km. The total area of Bank margin is one of the largest in the Tropical North Atlantic. The unusually clear oceanic water has allowed reef-building corals to occur at greater-than-usual depths.

Brief Summary of what is known

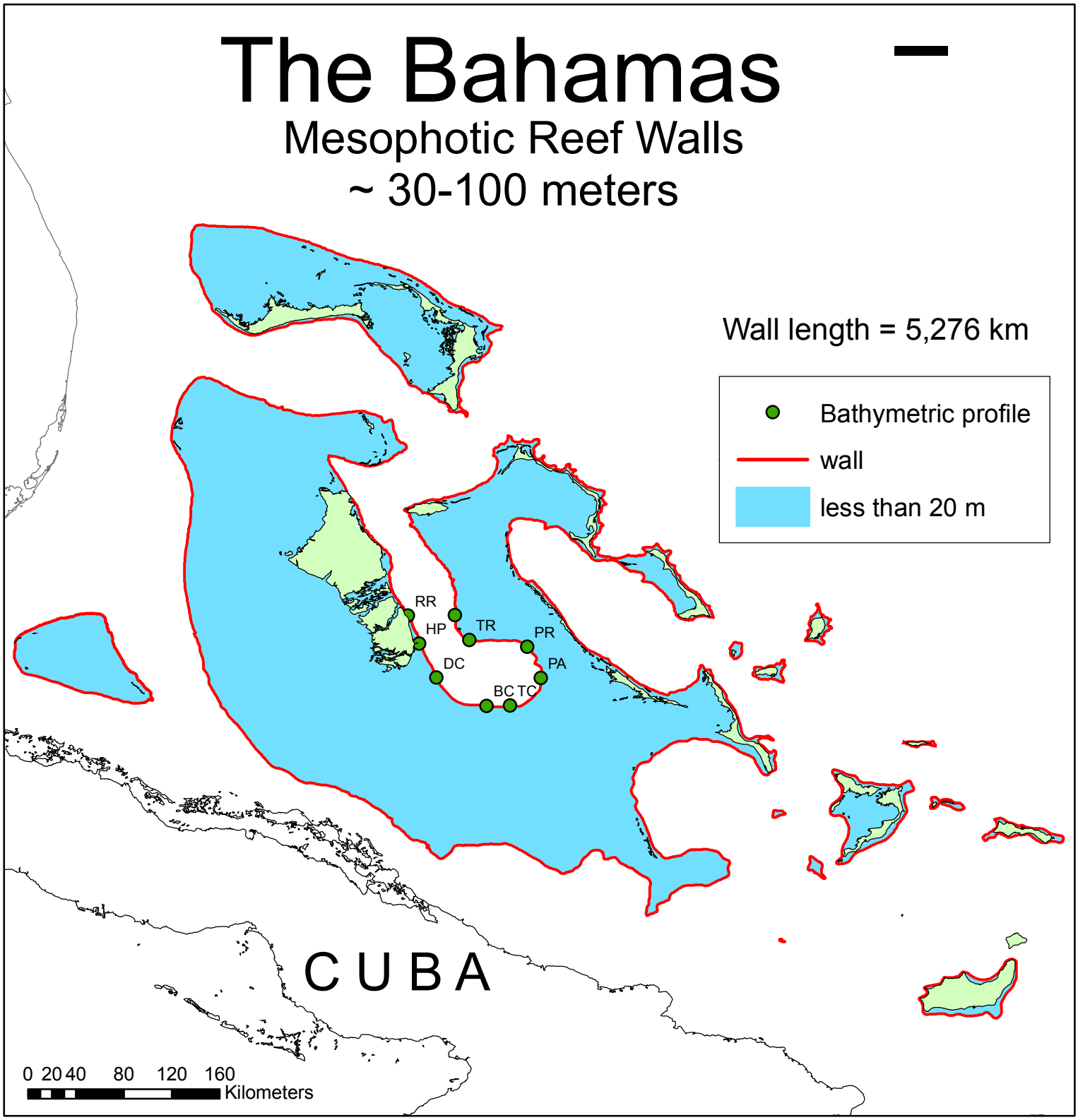
Reconnaissance observations using a mini-submersible have established the occurrence of the MCE Community of corals and
associated benthos at several sites on the open ocean-facing platform walls and in the semi-protected Tongue of the Ocean. Syndepositonal submarine cementation probably plays a key role in maintaining the near-vertical platform walls to depths of 80m
and in providing a supply of hard surfaces for the settlement of corals and other attached benthos. These walls are known to support specimens of a rare and unusual slit-shelled snail (Pleurotomariidae). It is most likely that other new or unusual benthos exist on or within these unexamined platform margins. The corals of the MCE include species similar to those from shallow reefs (montastrids; agaricids for example).

Rational for Exploration

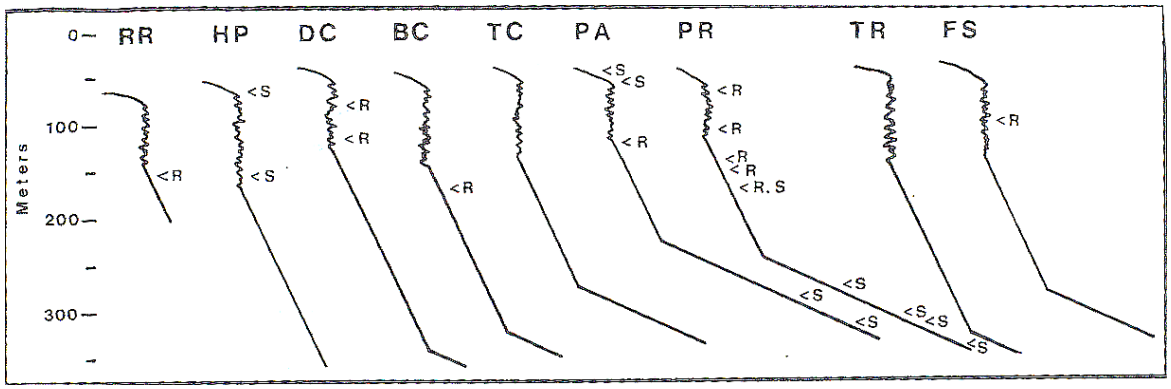
The Bahama Banks are one of the most extensive areas of potential habitat for the MCE community in the entire Tropical North Atlantic. The unusual configuration of the banks provides a variety of different settings: 1) open ocean-facing; interior margins of The Tongue of the Ocean; south-facing margins fronting a narrow seaway (Old Bahama Channel); margins facing the Straits of Florida, and on Little Bahama Bank, margins facing the Blake Plateau. The similarity in the species of corals of the MCE and those of the more familiar shallow reefs suggests they could be con-specific.
If the two occurrences of reef-building corals are related, then the extensive MCE coral community could be a refugio to replenish degraded shallow reef corals.

The Bahamas

Mesophotic Reef Walls
~ 30-100 meters



Wall Profiles



<R = Rock samples
<S = sediment samples

Target Name : SLOPE OFF CAPE HATTERAS, North Carolina

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other - DEEP SEA CORAL VMEs

Contact Information

Dr. Robert GEORGE
The George Institute, 1320 Vanagrif Ct. wake Forest, NC 27587
georgeryt@cs.com
919-437-6582

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-	
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-	

Brief Overview of Area

Over View of the Area of Interest for Exploration: We are in the process of proposing a new "National Marine Sanctuary' off the coast of North Carolina as an out- come of a workshop conducted on Oct. 15, 2010 at the North Carolina Central University Law School in Durham, NC. Please see the attachment for details of the participants and agenda. Our focus is an area off Outer Banks and Cape Haterras, stretching over the continental shelf to the EEZ boundary (200 miles limit). The shelf area of this region is routinely surveyed by the NOAA Northeast Fisheries, seasonally by intensive scientfict trawling. However, the area beyond shelf break over the slope and northern Blake Plateau is poor known although I have identified and described the fish, shrimps and corals in the Agassiz Coral Hills at the northern tip of Blake Plateau (George, 2002).

Brief Summary of what is known

What do we know of this Area?: NOAA - NURP at UNCW investigated this area at the so called "POINT" by using the Harbor Branch submersible Johnson-Sea Link when this area was leased for oil exploration. But the oil drilling plan was suspended and further work was not done because of the moratorium. I have received a grant from NURP to study the videos taken around "POINT" and found the bottom biotope rich in biomass and fish diversity. Nevertheless, our knowledge is very limited and this area offers new opportunities to consider as potential 'Deep-water Sanctuary' under the Sanctuary Act.

Rational for Exploration

To designate a new National Marine Sanctuary off Cape Haterras, North Carolina

This Workshop on Establishing a New Marine National Monument is Co-Sponsored by

GEORGE INSTITUTE
FOR BIODIVERSITY AND SUSTAINABILITY
1320 Vanagrif Ct.
Wake Forest, North Carolina 27587-4479 USA

About GIBS

The Institute is a 501(c)(3) nonprofit organization dedicated to promoting public awareness of the adverse impact of unwise exploitative activities (such as bottom-trawling, over-fishing, and hydrocarbon pollution) in the "Seas Around Us," with a specific focus on high-seas and deep-sea ecosystems. GIBS was instrumental in establishing the "Interagency Board for Deep-Sea Coral and Vulnerable Marine Ecosystems," sponsored by the Council on Environmental Quality.

The Purpose of this Workshop

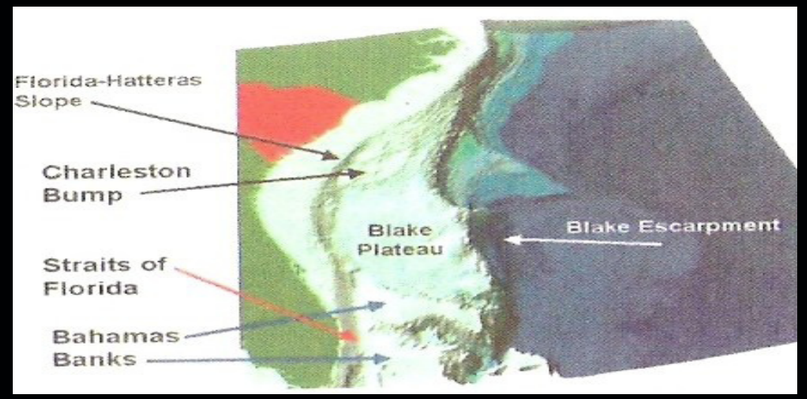
This workshop is a forum for discussing the merits of, and deterrents to, instituting a new National Monument. It brings together scientists, attorneys, and policymakers to focus on the Blake Plateau, an area off the southeast coast of the United States. Workshop participants consider the scientific, social, and legal issues surrounding National Monument designation, with an eye toward recommendations for moving forward.

The workshop organizers at North Carolina Central University School of Law

A WORKSHOP TO DISCUSS ESTABLISHING HEEZEN NATIONAL MONUMENT

North Carolina Central University School of Law
October 15, 2010 10:00 – 3:00

Sponsored by the Environmental Law Society
and the George Institute (GIBS)



Bruce Heezen National Monument

Hosted by North Carolina Central University School of Law

Agenda

10:00 **Opening and Welcome**

Raymond Pierce, Dean, North Carolina Central University School of Law
Ilesanmi Adaramola, President, NCCU Student Environmental Law Society
Robert Y. George, President, George Institute for Biodiversity and Sustainability

Keynote Address

10:15 **Marine National Monuments and National Marine Sanctuaries: What They Can and Cannot Do**

Billy Causey, Southeast Region Director, Office of National Marine Sanctuaries, National Oceanic and Atmospheric Administration

Workshop Session

Moderators: Kevin C. Foy and Robert Y. George

10:45 **The Blake Plateau: Deep-Sea Coral Ecosystems and the Idea for a Heezen National Monument**

Robert Y. George, George Institute for Biodiversity and Sustainability

11:05 **Geological Perspectives and the Connection Between Blake Plateau and Bruce Heezen**

Orrin Pilkey, Nicholas School of the Environment, Duke University

11:25 **Remarks: Wreck Fish Fisheries in the Blake Plateau**

Brian Cheuvront, Vice-Chair, South Atlantic Fishery Management Council &
Division of Marine Fisheries, North Carolina Department of Environment & Natural Resources

11:35 **Remarks: Chemosynthetic Ecosystems on the Blake Ridge**

Mary Turnipseed and Cindy van Dover, Nicholas School of the Environment, Duke University

11:45 **Perspectives on a National Marine Sanctuary**

John Rummel, Director, Institute for Coastal Science and Policy, East Carolina University

12:05 **Informal Discussion and Luncheon**

1:00 **Legal Perspectives on Establishing a National Monument**

Janet Steddum, NCCU School of Law
Kevin C. Foy, NCCU School of Law

1:20 **Lessons from the Gulf of Mexico: Status of Shelf-Edge Mesophotic Reefs in the Northeastern Gulf**

Ken Sulak, Lead Scientist, United States Geological Survey

1:40 **Protection of Large-Scale Marine Spaces and Current U.S. Opportunities**

Phil Kline, Senior Ocean Campaigner, Greenpeace USA

2:00 **Roundtable Discussion**, **Next Steps, and Conclusion**

Moderators: Billy Causey and Robert Y. George

3:00 **Adjourn**

Organizers

Robert Y. George, President, George Institute for Biodiversity and Sustainability
Kevin C. Foy, Assistant Professor, North Carolina Central University School of Law
Orrin Pilkey, Professor Emeritus, Nicholas School of the Environment, Duke University

Keynote Speaker

Dr. Billy Don Causey is Southeast Region Director at the Office of National Marine Sanctuaries, National Oceanic and Atmospheric Administration. Dr. Causey has managed the Florida Keys National Marine Sanctuaries for more than twenty-five years. He is a coral reef ecologist with expertise in marine zoning, sustainable management, and climate change.

billy.causey@noaa.gov

Speakers

Robert Y. George, President, George Institute for Biodiversity and Sustainability
georgeryt@cs.com, 919-435-6582

Orrin Pilkey, James B. Duke Professor Emeritus, Duke University
opilkey@duke.edu, 919-684-4238

Brian Cheuvront, Vice-Chair, South Atlantic Fishery Management Council
brian.cheuvront@denrnc.gov 252-808-8015

John D. Rummel, Director, Institute for Coastal Studies and Policy, East Carolina University
rummelj@ecu.edu 252-328-1755

Kenneth Sulak, Lead Scientist, US Geological Survey
ksulak@usgs.gov 352-264-3500

Janet Steddum & Kevin Foy, NCCU School of Law
kfoy@nccu.edu 919-530-7818

Phil Kline, Senior Policy Adviser, Greenpeace, Washington, D.C.
phil.kline@greenpeace.org 202-319-2402

Mary Turnipseed, Nicholas School of the Environment, Duke University
mary.turnipseed@duke.edu

Participants

Alexander Glass, Nicholas School of the Environment, Duke University
alex.glass@duke.edu 509-607-1868

Wilson Laney, South Atlantic Fisheries Coordinator, U.S. Fish & Wildlife Service
wilson_laney@fws.gov 252-339-5717

Target Name : BLAKE SPUR, SOUTHEAST US OFF GA/SC

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Mr. Andrew Shepard
University of North Carolina Wilmington
sheparda@uncw.edu
910-512-3506

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Under customary international law, as reflected in the Convention on the Law of the Sea, every coastal Country automatically has a continental shelf out to 200 nautical miles from its shore (or out to a maritime boundary with another coastal Country). In some cases, a coastal Country can have a continental shelf beyond 200 nautical miles if it meets certain criteria. The portion of continental shelf beyond 200 nautical miles is called the "extended continental shelf" (ECS). The U.S. ECS Task Force directs and coordinates the US ECS Project, an effort to delineate the U.S. continental shelf beyond 200 nautical miles. There are six areas in which the U.S. likely has an extended continental shelf (ECS): the Atlantic Margin, Arctic Ocean, Bering Sea, off the west side of Guam/Northern Mariana Islands, and in two areas in the Gulf of Mexico. The United States has sovereign rights over the resources on and under the seabed in its EEZ and ECS, including "sedentary" creatures such as clams, crabs, and corals. In addition to living resources, the ECS contains hydrocarbon resources (oil, gas, gas hydrates) and mineral resources, such as manganese nodules, ferromanganese crusts, and polymetallic sulfides (http://www.state.gov/g/oes/continentalshelf/). An area known as the Blake Spur is one of the few areas on the US Atlantic east coast that is unresolved ECS (Figure 1a).

Brief Summary of what is known

According to Gloria Atlas surveys, the Blake Spur at 30-00N 76-12W terminates in a steep rocky escarpment (http://coastalmap.marine.usgs.gov/gloria/eastcst/geology.html); as described at the USGS site, the Blake Spur is the steepest portion of the Blake escarpment. "Submersible dives at the spur show that the cliff there is near vertical over much of its extent. This extreme steepness is an indication that the cliff has formed by erosion rather than by accumulation, because the front of a carbonate (limestone) platform normally is more gently sloping than this (the Blake Plateau in this region is considered to have been formed as a carbonate platform, analogous to the present Bahamas. Erosion of the base of the escarpment has been at least 10 km. Strong sea-floor currents that flow southward have created a scoured depression off the end of the Blake Spur that extends southward as a moat along the eroded part of the escarpment." Previous in situ transects by submersible and towed camera (Knebel, 1984; Land et al. 1999) described the geology, but not the living resources.

In 2003, OER sponsored the Windows to the Deep expedition to explore methane seeps and chemosynthetic communities on the Blake Diapir on the Blake Ridge located at 32-30N and 76-11W at depths of 2000-2160 m (http://oceanexplorer.noaa.gov/explorations/03windows/welcome.html; Van Dover et al. 2003). This site is about 90 nm north of the Blake Spur and parts of both features lie in the ECS just outside the current EEZ boundary (Figure 1a), at depths of 900 to 4000 meters.

Rational for Exploration

The ECS Task Force Strategic Plan, "The National Effort to Establish the Full Extent of the Continental Shelf of the US" (http://www.flipseekllc.com/mmsextendshelf.html) calls for both mapping and characterization of resources. The University of New Hampshire's Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) is collecting multibeam bathymetry and acoustic backscatter data that can be used to support an extended continental shelf under Article 76 of the United Nations Convention of the Law of the Sea (UNCLOS) (http://www.ccom-jhc.unh.edu/index.php?p=51|56&page=law_of_the_sea.php (Mayer et al. 2002).

In 2008, CCOM led a mapping expedition off the Atlantic coast, just outside the EEZ (Calder and Gardner, 2008). Resulting MBES survey results (XYZ and ESRI files) of the Blake Spur region are posted at http://www.ccom.unh.edu/index.php?p=24|41|52|57|68|51|56&page=unclos/atlantic.php (Figure 1b). The proposed EX expedition will utilize exisiting acoustic surveys to target ROV transects intended to describe the biological communities and generate baseline habitat maps.

LITERATURE:

- Calder, BR, and JV Gardner. 2008, U.S. Law of the Sea Cruise to Map the Foot of the Slope of the Northeast U.S. Atlantic Continental Margin: Leg 6, University of New Hampshire (UNH), Center for Coastal and Ocean Mapping (CCOM)/Joint Hydrographic Center (JHC), Durham, NH, 131p.
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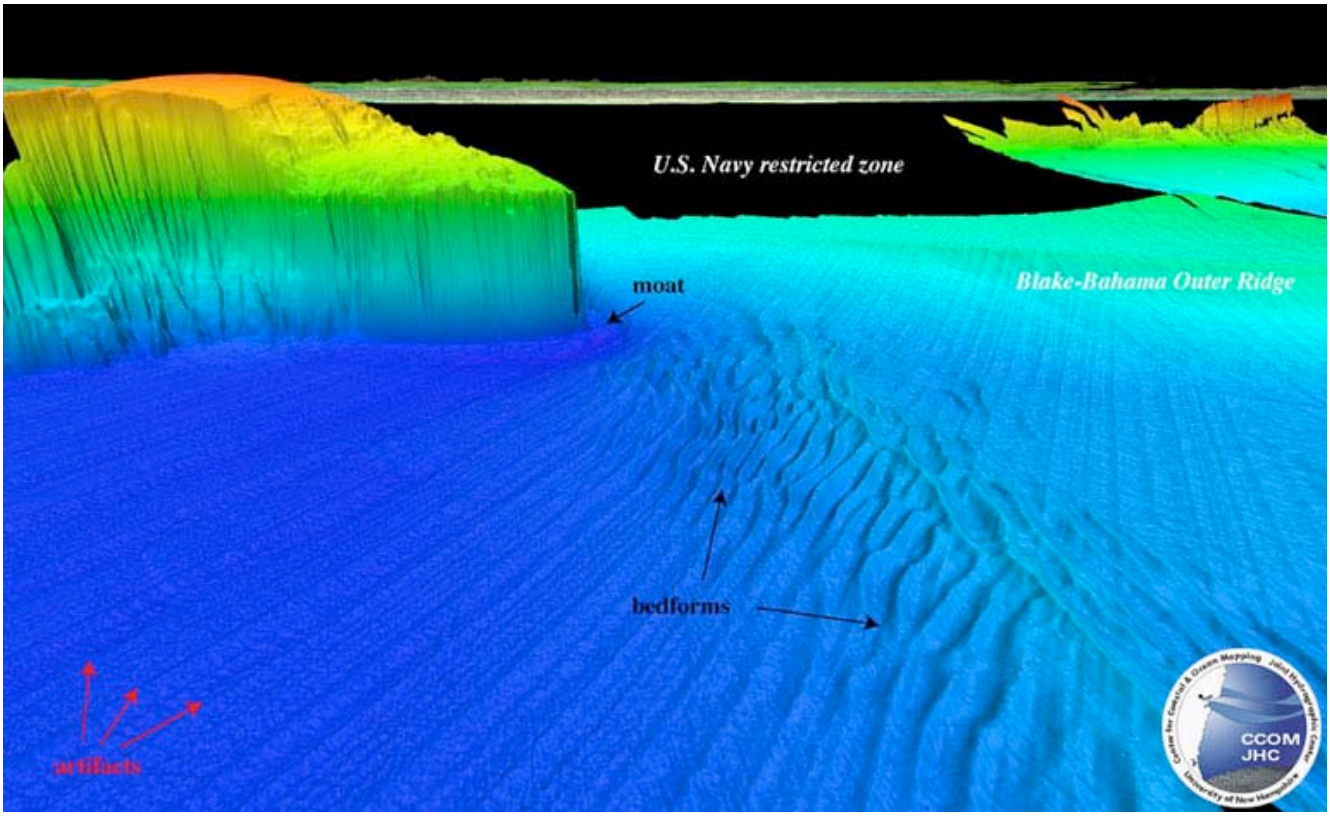
Volume 61, Issue 1, October 1984, Pages 43-74
- Land, LA, CK Paull, and FN Spiess. 1999. Abyssal erosion and scarp retreat: Deep Tow observations of the Blake Escarpment and Blake Spur. Marine Geology 160: 63–83.
- Mayer, LA, M Jakobsson, and AA Armstrong. 2002. The Compilation and Analysis of Data Relevant to a U.S. Claim Under United Nations Law of the Sea Article 76: A Preliminary Report, University of New Hampshire (UNH), Center for Coastal and Ocean Mapping (CCOM)/Joint Hydrographic Center (JHC), Durham, NH, 75p.
- Van Dover CL, P Aharon, JM Bernhard, E Caylor, M Doerries, W Flickinger, W Gilhooly, SK Goffredi, K Knick, SA Macko, S Rapoport, EC Raulfs, C Ruppel, J Salerno, RD Seitz, BK Sen Gupta, T Shank, M Turnipseed, R Vrijenhoek. Blake Ridge methane seeps: characterization of a soft-sediment, chemosynthetically based ecosystem. Deep-Sea Research I (50): 281-300.

Figure 1. a) top- US EEZ showing Blake Ridge (BR) and Blake Spur (BS). b) bottom- multibeam image from CCOM 2008 survey of Blake Spur (looking from south to north).



Target Name : Neck of the Strait of Florida

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Drs. Charles Messing
Nova Southeastern University
messingc@nova.edu
954-850-6990

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Strait of Florida is a reversed L-shaped trough that separates the Florida Peninsula from the Bahama Platform and Cuba. Though a relatively small channel on the edge of the Atlantic, it serves as both conduit and barrier, and so forms an important biodiversity hotspot. The Strait's primary hydrographic feature, the Florida Current, creates the conduit, channeling back to the North Atlantic much of the water volume lost to the Southern Hemisphere via the deep thermohaline conveyor. By contrast, the current's geostrophic flow, water mass properties, and the features of the Strait's margins create important biological barriers. At the bend of the L, the Pourtalès Terrace Escarpment south of the Florida Keys, and Cay Sal Bank, an outlier of the Great Bahama Bank, lie separated by only 45 km. This narrow neck, and the channel floors immediately to the north and west, remain largely unexplored.

Brief Summary of what is known

The narrow central neck of the Strait lies adjacent to the boundary between the carbonate province of the Florida Peninsula/Bahama Banks and the tectonic province of the Greater Antillean Arc. The area forms an important biogeographic boundary separating the continental fauna of the Florida Slope from the insular fauna of the Bahama/Cuba slopes. The Strait was the site of the first deep-sea research in the United States, which pre-dated the "Challenger" Expedition (Pourtalès 1867 1871). Before the 1960s, when the University of Miami began extensive deep trawling off the Florida and Bahama margins, deep benthic biology was largely restricted to Cuban coasts (e.g., Agassiz 1888). Those operations vastly increased our knowledge of the deep benthic fauna in the Strait (e.g., Halpern 1970, Holthuis 1971 1974, Meyer et al. 1978, Cairns 1979 1986). Modern mapping also began in the 1960s (e.g., Jordan & Stewart 1961, Jordan et al. 1964, Kofoed & Malloy 1965, Malloy & Hurley 1970) and was followed by the first manned submersible operations (e.g., Ballard & Uchupi 1971, Neumann & Ball 1970, Neumann et al. 1977). Since then, detailed investigations using submersibles, ROVs, and high-resolution swath bathymetric mapping have largely been restricted to the Miami and upper Pourtalès Terraces, and portions of the deep-sea reef and carbonate mound habitats of the northern Strait (e.g., Messing et al. 1990 2006, Anselmetti et al. 2000, Grasmueck et al. 2006 2007, Reed et al. 2005 2006). The Florida Current has, of course, been the subject of extensive theoretical and synoptic research (e.g., Duing 1973 1975, Leaman et al. 1987, Schott et al. 1988, Lee et al. 1996, Wang & Mooers 1997, Shoosmith et al. 2005).

The Strait thus supports a bewildering diversity of biological assemblages and geological features, including lithoherms and other carbonate mounds, azooxanthellate coral build-ups, relict limestone terraces, faulted escarpments, and downslope gullies.

Rational for Exploration

Although much of the Florida and northwestern Bahama margins of the Straits, and the Florida Current itself, are well-studied, much of the southern half, particularly the Cuban slope, is largely unknown. Cay Sal Bank represents the closest accessible feature to the Cuban slope that is also affected by the Florida Current. The deep Cuban slopes have not been investigated for over 70 years, with much of the work conducted over a century ago. The narrow neck between the unexplored outer escarpment of the Pourtalès Terrace and Cay Sal Bank, compresses a major biogeographic boundary and important ocean current into a relatively small area, where their effects are magnified and can be understood more clearly. Recent limited mapping of the Strait floor north of Cay Sal Bank revealed a series of large carbonate features, each completely different; nothing is known of the extent or true diversity of these structures, at least some of which support deep-sea corals (and are unlike any other features to the north). The proximity of the site to U.S. shores, the downstream location relative to the Gulf of Mexico, and the complexity of the physical and biological environments, make this area an excellent candidate for the kind of systematic exploration that will describe new habitats and phenomena, establish a foundation of information that will catalyze further exploration, research, and education, and act as a potential sentinel for the effects of climate change.

Target Name : Physalia and Mytilus Seamounts

Why this area may be of interest

Biology - Unknown distribution and abundance of seamount megafauna (corals, sponges, fishes)
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Peter Auster
University of Connecticut
peter.auster@uconn.edu
860-405-9121

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

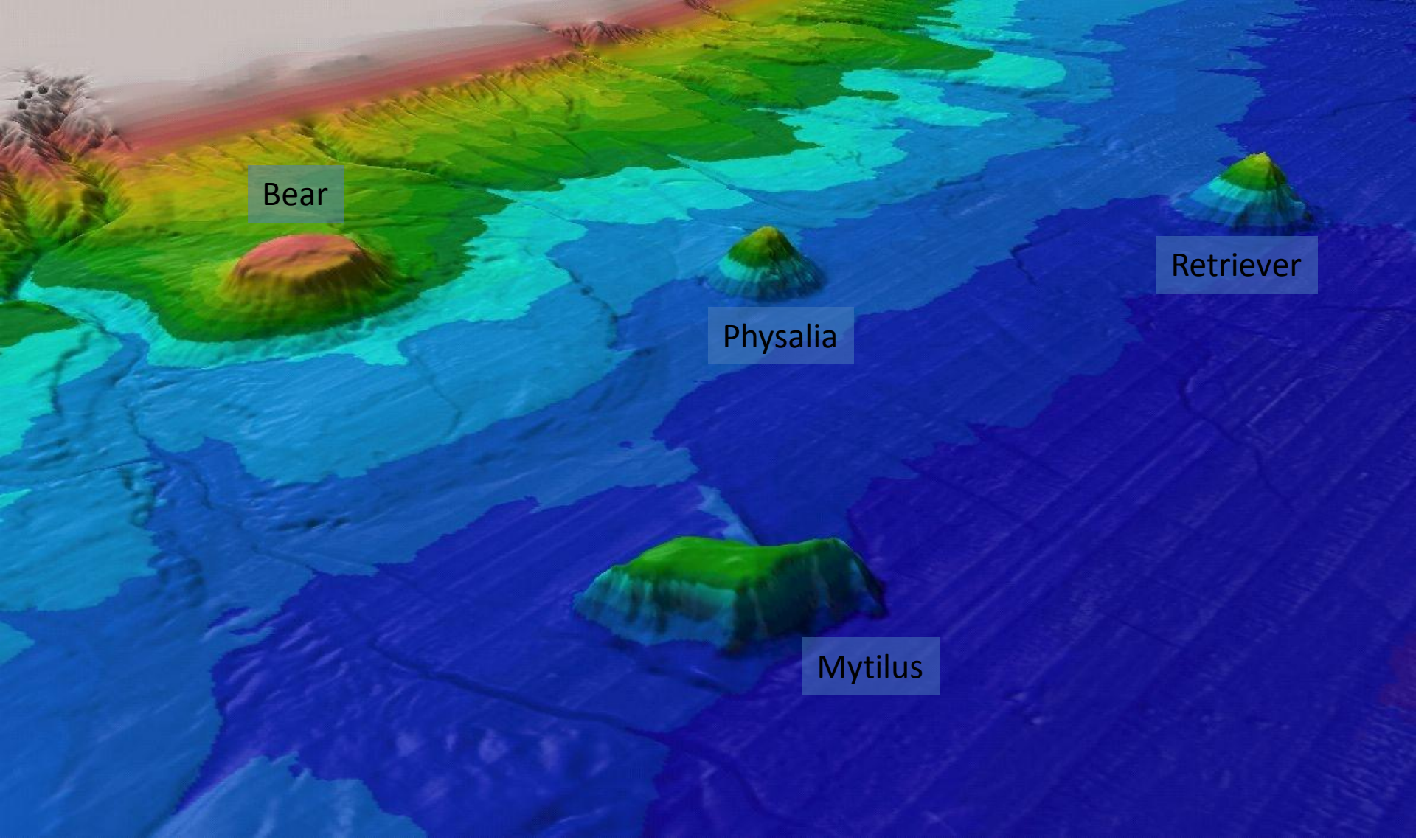
Four of the westernmost seamounts in the New England Seamounts chain are within the U.S. EEZ (i.e., Bear, Physilia, Mytilus and Retriever Seamounts) with summit depths ranging from ~1000-3000 m. Both Bear and Retriever Seamounts have been visited during two previous OE funded cruises (two Alvin dives at Bear, two Hercules dives at Bear and one on Retriever) and limited observations have revealed diverse sponge and coral communities around the upper slopes and rocky summits. These seamounts emerge from the lower continental rise as it transitions to the Sohm Abyssal Plain and are influenced by both the western side of the Gulf Stream as well as deep Laurentian Shelf Water as it moves west along the continental margin on the southern edge of Georges Bank.

Brief Summary of what is known

Based on previous OE funded efforts, our team of collaborators has found a diversity of basin scale patterns across the northwest Atlantic seamounts (e.g., related to population connectivity of corals, commensal relationships of coral associated invertebrates as well as between fish and other invertebrates, geographic scale patterns of fish diversity in canyons and on seamounts, range extensions and inferred processes of connectivity in fishes, and habitat use of corals by deep sea fish). However, we know little about variation in geographically adjacent seamounts or the level of effort required to adequately explore such features (e.g., encounter 90% of species within any major taxa).

Rational for Exploration

Both Physalia and Mytilus Seamounts remained wholly unexplored. Like individual mountains in mountain chains on land, exploration of each feature can reveal new information and insights. In the present case, there are opportunities for new knowledge and rapid use of such information by the ocean management community. Are there differences in fauna based on orientation to prevailing flow regimes? Are there characteristic faunas from the western seamounts that the existing level of exploration did not reveal because of limited sampling? The New England Fishery Management Council is in the process of designating the summits of both Bear and Retriever Seamounts as Habitat Areas of Particular Concern (under Magnuson authority) solely based on our primary observations of Red Crab during our video traverses. These seamounts may also be designated coral conservation areas by the Council based on our observations of deep sea coral and sponge taxa. However, with no observations from Mytilus and Physalia, managers are unable-unwilling to infer similar distributions and require a minimum level of exploratory information to act. Further, there are ongoing discussions about collaborative assessments for conservation measures of seamount and canyon regions between NMFS and the National Marine Sanctuary Program. Information from exploratory work will greatly aid in this regard.



Western New England Seamounts inside the US EEZ. Note dendritic patterns extending from canyons and across the continental rise.

Target Name : Tele-presence for the Discovery and Management of North Carolina's Battle of the Atlantic Resources

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology - X
Other -

Contact Information

Dr. Nathan Richards
UNC-Coastal Studies Institute and East Carolina University
richardsn@ecu.edu
252.258.4264

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

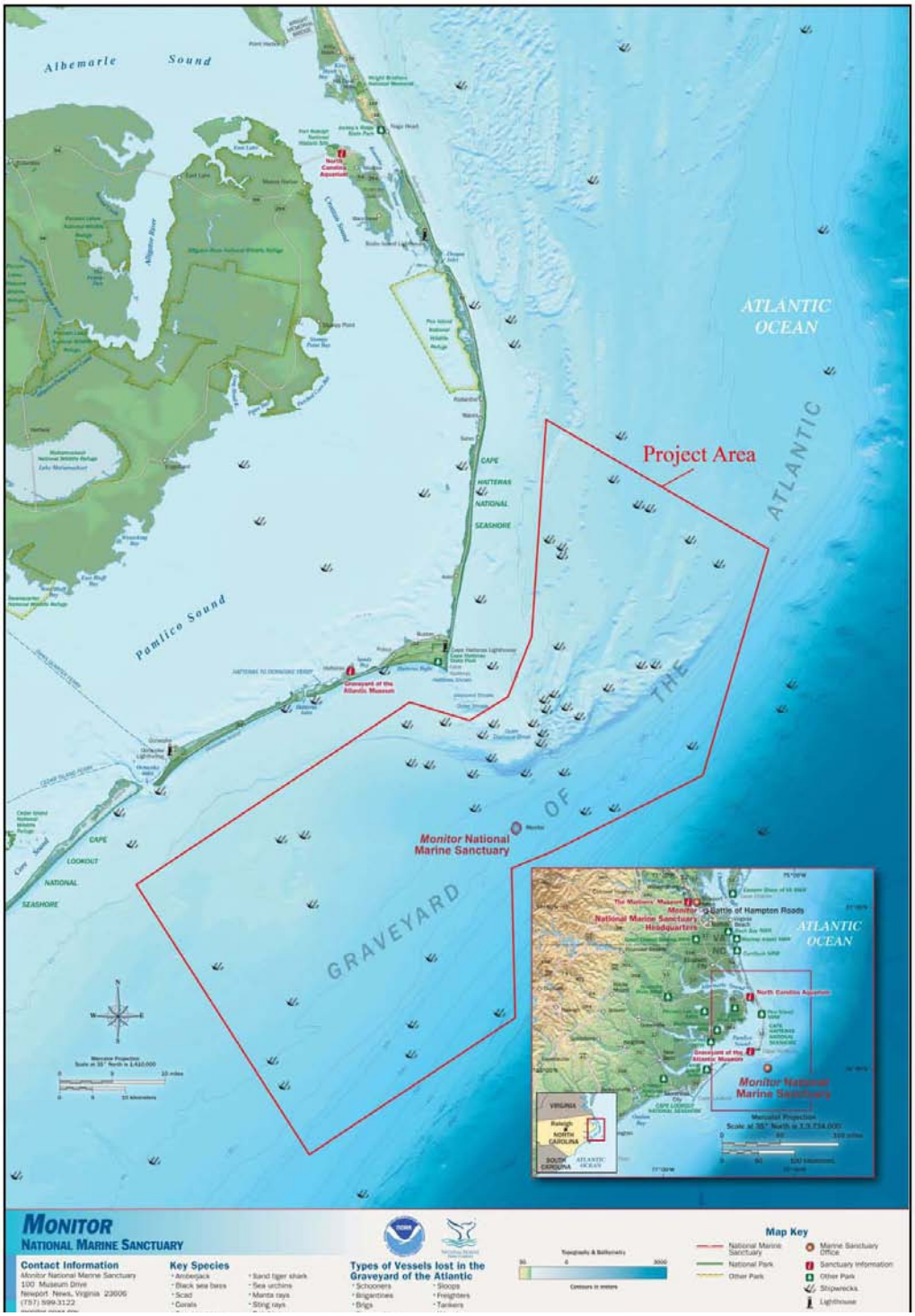
The waters off of North Carolina are an interface for two major oceanic currents (cold northern waters from the Labrador Current, and warm southern waters from the Gulf Stream) which create varying geophysical and biological effects. Of particular interest are sites lying in highly dynamic areas where the Gulf Stream and the Labrador collide, where a high degree of variability in currents occurs and has a noticeable effect on shifting sands (creating deep scours and deposits which shift continually.) This is believed to cause times when shipwrecks are buried and then uncovered, dramatically altering preservation levels. Of equal importance are the relatively unchecked influences of human threats to sites due to unmeasured levels of structural damage caused by fishing, anchoring, and salvage activities, as well as souvenir hunting by SCUBA divers. Little is known about cultural resources on the deeper waters of the Continental Shelf and Slope.

Brief Summary of what is known

Since 2008, a multi-agency (NOAA-led), interdisciplinary collaboration of private, state, and federal entities, encompassing cultural resource management and academic experts as well as private citizens has commenced with the task of finding, documenting, and assessing the submerged cultural resources of the Battle of the Atlantic in the hotspot of the conflict—the waters off North Carolina. This is a rare opportunity to operate with support from NOAA, as well as other federal agencies as they focus on maritime heritage resources in NC. Cost sharing, both real and in-kind has been committed from NOAA and shared access to resources and infrastructure will aid in the successful completion of this project. East Carolina University has also developed the RENCI Center for Coastal Informatics and Modeling that offers expertise and computation and visualization infrastructure to augment field studies, conduct spatial analyses, and develop GIS and cartographic products.

Rational for Exploration

While some popular diving literature outlines the location of a handful of World War Two shipwrecks within recreational and technical diving limits, the location and state of preservation of the majority of submerged cultural resources left in the wake of naval conflicts off the eastern seaboard of the USA between German and Allied watercraft during this conflict is currently poorly known. Many sites yet to be discovered are located in the deeper waters of the continental slope and beyond where anthropogenic impacts are minimal. By discovering and archaeologically assessing these resources, researchers hope to commence the process of compiling a definitive archaeological inventory to supplement historical records. In the process, this research will also serve to provide baseline evidence to initiate site preservation and interpretation activities and better define the boundaries of the conflict for future management and planning purposes. Telepresence may serve a critical role in both the discovery and management of these important submerged sites.



Target Name : Jordan Basin and Schoodic Ridges - Gulf of Maine

Why this area may be of interest

Biology - Distribution of remnant deep sea coral habitats in western Gulf of Maine
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Mr. Ivar Babb
University of Connecticut
ivar.babb@uconn.edu
860-405-9121

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

An isolated site in western Jordan Basin composed of hard substratum that rises above the surrounding soft sediments as well as a deep slope site off Mount Desert Rock were dominated by deep sea corals. These isolated sites seemingly contain remnant populations of deep sea corals that were widely distributed up to a half century ago. These sites are bathed in Gulf of Maine deep water that seems to limit distribution of corals.

Brief Summary of what is known

We know two sites harbor deep sea corals based upon a very limited NURP-sponsored exploration of a small portion of this area in 2005.

Rational for Exploration

Multibeam mapping of a segment of western Jordan Basin and north to Schoodic Ridges with subsequent groundtruth imagery via ROV (camera sled and similar tools are not optimal tools in this precipitous terrain) is the primary goal of this proposal. In the present case, there are opportunities for new knowledge and rapid use of such information by the ocean management community, directly addressing OER Strategic Goals "Transitioning Exploration to Research (E2R) and Research to Application/Management (R2A).

Despite 50 years of oceanographic research in the Gulf of Maine, much remains unexplored. In fact, thirty year old bathymetric fishing maps indicate that the proposed area is comprised of very rough topography, only a fraction has been mapped using multibeam sonar during the 2005 expedition, which revealed a complex series of bumps rising from the basin. The extent of deep water coral distribution in these complex topographic areas is unknown. The need for coastal exploration must not be overlooked.

Target Name : Knauss Seamount

Why this area may be of interest

Biology - Unknown distribution and abundance of seamount megafauna (corals, sponges, fishes)
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Mr. Ivar Babb
University of Connecticut
ivar.babb@uconn.edu
860-405-9121

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Knauss Seamount is located at: 37° 24' 00" N, 70° 52' 00" W, rising from 4100 meters to 2900 meters at its summit. This feature, a 1200-m high seamount SW of New Jersey on the Atlantic continental rise was named Knauss Knoll in 1967 but has remained unexplored.

Brief Summary of what is known

Mulitbeam sonar conducted by Gardner et al. as part of the Law of the Sea Extended EEZ initiative reveals the seamount to rise dramatcially from a featureless bottom, that has been characterized by Gardner as an area of low backscatter, perhaps due to gas. It is posited by Vogt (1991) that this feature was formed by the hotspot hypothesis, with Knauss pre-dating Muir Seamount. The multibeam imagery revealed sediment banked against the back of the seamount, a result of the strong Western Boundary Current, as has also been observed for Mytilus Seamount. This seamount is also likely impacted by deep Laurentian Shelf Water as it moves west along the continental margin on the southern edge of Georges Bank. The distribution of deep sea corals, sponges and fishes associated with this feature are unknown.

Rational for Exploration

Knauss Seamount and the intriguing adjacent low backscatter remain unexplored. The potential for the seamount to harbor taxa similar to more southerly canyons or more northerly seamounts is high, but unanswered. What role this feature may play in connectivity between southern and northern taxa is also unknown. Are there differences in fauna based on orientation to prevailing flow regimes? Similar to the proposal by Peter Auster to explore Physalia and Mytilus seamounts, the New England Fishery Management Council is in the process of designating the summits of both Bear and Retriever Seamounts as Habitat Areas of Particular Concern (under Magnuson authority) solely based on our primary observations of Red Crab during our video traverses. Fundamental observations are needed in order to provide a baseline for any similar, potential management actions.

Target Name : Wilmington Canyon: Systematic Exploration of the Head of Wilmington Canyon Guided by Targeted Exploration of Hudson Canyon

Why this area may be of interest

Biology - Essential fish habitat, deep-sea corals, chemosynthetic ecosystems
Geology - Canyon processes including sedimentation, gas hydrates, and slope stability
Chemical Oceanography - Methane geochemistry related to gas hydraes and free gas
Physical Oceanography - Canyon currents and water masses and their role in essential fish habitat
Marine Archaeology - Area of historic wrecks
Other - Multidisiplianry investigagtion involving all of the above categories

Contact Information

Drs. Peter Rona, Vince Guida, Mary Scranton, Donglai Gong
Rutgers University, NOAA NE Fisheries Science Center, Stony Brook University, WHOI
rona@marine.rutgers.edu and Vincent.Guida@noaa.gov
732-932-6555x241; 732-872-3042

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Wilmington Canyon and other major canyons of the mid-Atlantic US continental margin lie at the doorstep of the US northeast urban megalopolis and have profound environmental and resource impacts on the region. Yet these canyons are poorly known. Wilmington Canyon is one of the least known of the major canyons. It was last mapped by the NOAA National Ocean Survey in 1977, revealing features similar to Hudson Canyon, the largest of the east coast canyons, about 100 nm to the northeast. Both Wilmington and Hudson canyons connect with river systems, the ancestral Delaware (buried channel) and the Hudson (open Shelf Valley) rivers, respectively. Both canyons begin as bifurcated incisions into the outer continental shelf, exhibit high relief (~1000 m) segments that abruptly change trend from N-S to NW-SE from the shelf edge to the upper continental rise. Wilmington and Hudson canyons already are known as commercial and recreational fishing "hot spots".

Brief Summary of what is known

The NOAA National Ocean Survey (1977) bathymetric map of Wilmington Canyon has low bathymetric resolution compared with Hudson Canyon, which was recently mapped using a multibeam system (Butman, Twichell, Rona and others, 2002). Limited studies of sedimentary processes in the head of Wilmington Canyon have been made using conventional marine geological techniques. Our high-resolution (2 m) mapping of the head of Hudson Canyon to a water depth of 1000 m using an Autonomous Underwater Vehicle coordinated with water sampling has revealed circular depressions and strings of pockmarks venting methane from the canyon floor, with implications for chemosynthetic ecosystems, slope stability, climate warming, energy reserves, and management of fisheries and habitat resources. Other discoveries include massive outcrops in the walls that may harbor deepwater coral communities, bottom areas bioengineered by tilefish (pueblo villages), and the locations of wrecks. Wilmington Canyon is ripe for systematic exploration which has the potential to reveal new canyon features and processes.

Rational for Exploration

Our rationale for exploration of Wilmington Canyon, like that for Hudson Canyon, is to advance multi-disciplinary understanding of features and processes of canyon heads with reference to essential fish habitats that support commercial and recreational fish stocks and other aspects in support of NOAA and national objectives. Both canyons are under consideration as a, "Habitat Area of Particular Concern", by the New England Fishery Management Council, but cannot be so designated without specific geo-referenced information, currently needed. We propose to systematically explore the head of Wilmington Canyon from the shelf edge to the upper continental rise using the shipboard multibeam system for high-resolution bathymetry, CTD-rosette for physical oceanography and geochemistry (methane), and ROV for seafloor imagery. Our exploration of Wilmington Canyon will be guided by our exploration of Hudson Canyon which now is in a targeted phase requiring ROV imagery of the circular depressions and other sites to illuminate specific habitats for finfish, deepwater corals and possible chemosynthetic ecosystems. Both canyons lie at the doorstep of major metropolitan areas, so that our exploration has the potential to capture the public imagination through a full educational and outreach program.

Target Name : Outer Continental Shelf, Mid-Atlantic Region.

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology - X
Other -

Contact Information

Dr. Rod Mather
University of Rhode Island
rodmather@mail.uri.edu
401 874 4093

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The area we would like to suggest for systematic exploration encompasses the Outer Continental Shelf off Virginia from Norfolk Canyon to Washington Canyon and extends out from the edge of the shelf for a distance of about 30 miles. Water depths in this area range from about 100 to 2500 meters. The area is important for both its biological and cultural resources. The latter include a collection of nine German warships from WWI (the so-called "Billy Mitchell fleet") and the wreck of the British tanker San Demetrio.

Brief Summary of what is known

On the 17th March 1942, the German U-boat U-404 sank the 8073-ton, British tanker San Demetrio. The tanker went down about 80 miles east of the Virginia Capes (37.03N, 73.50W). She had been bound from Baltimore to Halifax, NS, at the time. Thirty-two crewmen survived; nineteen perished. While attacks of this nature were common during WWII, particularly in 1942, this was no ordinary tanker. She had been attacked before, in November 1940, by the German Heavy Cruiser the Admiral Scheer. With their vessel on fire and likely to explode, the captain and crew of the San Demetrio abandoned ship. After two days floating in the freezing north Atlantic the crew came across their vessel again – still on fire. They re-boarded her, put out the fire, rigged a temporary steering system and used celestial navigation to sail back to Britain. The story of the San Demetrio captured the public's imagination and was turned into a movie titled "San Demetrio, London" starring Walter Fitzgerald, Mervyn Johns, Ralph Michael, and Robert Beatty.

Rational for Exploration

The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), in cooperation the National Oceanic and Atmospheric Administration (NOAA), the Office of Ocean Exploration and Research (OER) and the U.S. Geological Survey (USGS) is interested in the Outer Continental Shelf, Mid-Atlantic Region as a potential area for off shore leasing. The area contains, however, significant biological and cultural resources. While BOEMRE has funded a study of this area, of which we are part, there is, at present, no vessel or cruise capable of surveying and mapping the deeper sections of the project area (ie. those in excess of 1500 meters), where the San Demetrio and other historically important wrecks are located.

Target Name : Puerto Rico Trench

Why this area may be of interest

Biology - .Tamara Frank, Charles Messing
Geology - Nancy Grindlay
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Tamara Frank
Harbor Branch Oceanographic at Florida Atlantic University
tfrank3@hboi.fau.edu
7722422311

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.- **Yes**
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Puerto Rico Trench, which reaches a maximum depth of 8600 m, is the deepest place in the Atlantic Ocean. It runs east-west for ~800 km, north of Puerto Rico along the plate margin between the westbound North American Plate and eastbound Caribbean Plate, with a small subduction zone to the southeast.

Brief Summary of what is known

The northern margin of the trench slopes downward from the Nares Abyssal Plain at a depth of 4200 m to a flat depression about 280 km long along the trench floor about 75 miles north of the island. The northern edg, at a depth of 4200 m, is cut by deep canyons. The southern slope, which includes a mud volcano at a depth of 7900 m and a limestone layer cut by narrow deep gullies, is effectively continuous with the northern island slope above sea level. The northward dipping limestone platform abruptly truncates at about 3000-3500 m, at which point the southern slopes becomes very steep and deeper sections of the island arc are exposed. Although extensive bathymetric surveys have been conducted, much of the region remains unmapped. Very little biological work has been conducted. Dredges (Staiger 1972) and box cores (Richardson et al 1995) on the trench floor to depths of 8300 m retrieved isopod, ostracod, harpacticoid copepod and tanaidacean crustaceans, anemones, and nematode and polychaete worms. Otter trawls conducted on the trench floor between 7200 and 8600 m collected holuthorians, isopods, amphipods and cumaceans (George and Higgins 1979).

Rational for Exploration

While the few studies that have been conducted on the trench floor report a fairly depauperate benthic assemblage, the deeper portions of the sloping walls have never been studied. The southern portion of the trench, which is composed of limestone, would be an ideal location for initial explorations of benthic and pelagic communities, as it starts on land and progresses towards the deeper portions of the trench. In addition, based on previous NR1 and Alvin studies that have commented on biology (although from the eyes of geologists), the southeast wall of the Mona Canyon and the top of Mona Block to the west of Mona Canyon are also good target locations. It would be extremely interesting to compare biological populations along a shallow to deep transect on the uniform carbonate platform of the southern slope vs. along the non uniform bottom-type of the SE wall of Mona Canyon. In addition, Pollack (1950) reported oxygenated AABW flows over the trench bottom in a westward direction, and this may intrude into Mona Canyon, providing a carbonate platform and nutrients required by deepwater corals. Extensive bathymetry via seasurface swath mapping has been conducted, but very high resolution mapping that can only be acquired by an ROV or AUV is needed. With the equipment available on the Okeanos Explorer, a simultaneous very high-resolution survey of the bathymetry and biology of this unique and fascinating environment could be conducted.

Target Name : North Atlantic

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. James Delgado
NOAA/ONMS/MHP
james.delgado@noaa.gov
301 713 7282

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-**Yes**	East. North Atlan.- **Yes**
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The North Atlantic is an area which has been an active seaway for centuries if not millennia with possible human migration at times of maximum glaciation as well the historic period.

Brief Summary of what is known

A variety of shipwreck sites are known, primarily more modern vessels, some at great depth such as Titanic (1912) and HMS Hood (1940). In shallower water, approaching ports such as Boston, many more wrecks are found, some of which have been located and surveyed by NOAA.

Rational for Exploration

1) Surveys in and in proximity to existing National Marine Sanctuaries on the Atlantic and Gulf coasts can assess potential significant submerged cultural resources as well as natural resources. In terms of cultural resources, significant shipwrecks not yet located off USS Monitor NMS can relate to two significant initiatives – the Battle of the Atlantic survey of WWII losses to the U-boat attacks on the US East Coast in 1942 as well as the RUST/RULET/PPW assessment of shipwrecks with a potential to leak oil or which have unexploded ordnance. At Florida Keys NMS, a yet undiscovered Spanish galleon from the treasure flota of 1733 is one of a group of significant shipwrecks in or in proximity to that Sanctuary.

2) A survey off and in proximity to Stellwagen Bank NMS can assess the potential for submerged prehistoric sites, older, less visible shipwrecks older that the 19th century, and Battle of the Atlantic wrecks off the coast of Massachusetts and Maine as well as the prehistoric continental shelf from the last glacial maximum.

3) OER can also consider, and we would be interested in working with OER, on systematic surveys of the major convoy routes to and from the US that were involved in the Battle of the Atlantic from 1941 to 1945, a major naval campaign that involved the US Navy and US Coast Guard as well as a large number of the US merchant marine.

4) We also propose a potential survey along the major sea lanes used in the seaborne immigration to the United States from the 16th to the 20th centuries. That movement of people by water created the United States, and resulted in a number of shipwrecks that now rest as potentially well-preserved shipwrecks with tremendous potential to yield information on not only the immigrant ships but the immigrants themselves through the baggage they loaded on to these ships to start a new life in the New World.

Target Name : Canyons of the Northeast Region

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Martha Nizinski
NOAA/NMFS/NEFSC/National Systematics Laboratory
Martha.Nizinski@noaa.gov
202-633-0671

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-**Yes**	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Northeast Region encompasses 260,000 square km and extends from the Gulf of Maine and Georges Bank southward through southern New England waters and the Middle Atlantic bight to Cape Hatteras as well as eastward from the coast to the continental slope and offshore to the Gulf Stream. This area supports extensive and intensive commercial and recreational fisheries. Additionally, this region is comprised of a variety of deepwater habitats, including a broad continental shelf/slope, the New England Seamount chain and deepwater canyons. Corals have been documented throughout the regions, but many records are based on historical trawl and catch data. Corals have been observed at the seamounts, in the deep basins of the Gulf of Maine, and some canyons (e.g., Norfolk). But several canyons have not been thoroughly investigated to document coral occurrence, diversity and abundance. We propose to explore Atlantis, Gilbert, Hydrographer, Washington and Wilmington canyons; canyons that are assumed to support corals but to date coral occurrence in these canyons has yet to be determined.

Brief Summary of what is known

The majority of deep coral distribution and abundance information from this area is based on historical records (e.g., Theroux and Wigley 1998) and has been compiled by Watling and Auster (2005), and Packer et al. (2007). Hecker and colleagues surveyed deep corals of the continental margin and several submarine canyons off the northeastern United States in the 1980's. Corals were denser and more diverse in the canyons and some species such as those restricted to hard substrates were found only in canyons. However, only the slope near the canyon mouth was sampled at some canyons while others were not surveyed. Recent OAR funded expeditions to the New England Seamount chain have shown that deep corals are one of the dominant members of the epifaunal communities at the seamounts. Fishery dependent and independent bycatch data from the Northeast region are minimal and vague.

Rational for Exploration

Deep-sea coral research in the Northeast Region is virtually nonexistent and as a result this region lags behind all other regions in our state of knowledge on diversity, distribution, and abundance of deep-sea corals. Although deep-sea corals are a primary focus within NOAA and listed specifically in the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act, little data have been collected. Information is needed in order to make sound management decisions. The New England and Mid-Atlantic Fishery Management councils have expressed interest in protecting deep coral habitat. However, given the present state of knowledge, it is difficult to advise the councils on where boundaries should be drawn. Mapping with associated video will be a first step towards understanding coral distributions and habitat composition in the region.

Maps of coral distributions are often based on historical records, yet some of these records are decades to a hundred years old. Given the intensive fishing activity throughout the region, anecdotal evidence suggests corals may no longer exist in areas where they were recorded previously. Thus, it is necessary to groundtruth deep coral distributions. Canyons are likely places to find corals, therefore, exploration of canyons is proposed here. These canyons were selected for exploration because no records documenting the presence of deep-sea corals exist. However, deep corals are assumed to occur in these canyons since corals have been observed in some canyons in the region. Inter-canyon areas, areas that could support organisms such as sea pens and sponges, organisms that could provide essential fish habitat, should also be explored. Very little is known about inter-canyon areas either.

Target Name : Vulnerable North Atlantic Ocean Basin Deep-Sea Ecosystems (a TRACES proposal)

Why this area may be of interest

Biology - Actually all of these categories except archaelology would apply to this proposal.
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Drs. Steve Ross, Sandra Brooke, Liz Roberts, J. Murray Baird
Univ. of NC at Wilmington, Marine Conservation Biology Inst., Heriot-Watt Univ., NC Museum of Natural Sciences
rosss@uncw.edu
910-962-2346

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-**Yes**	East. North Atlan.- Yes
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The continental margin of the North Atlantic Ocean is well known for rugged habitats (canyons, reefs, seamounts), strong currents (e.g., Gulf Stream, Antilles, Irminger) which influence climate and ocean productivity, highly productive fisheries, and high levels of human impact. Continental margins are now considered some of the most active and productive areas of the world's oceans. These deep areas remain poorly explored by scientists, although fisheries and hydrocarbon exploration are rapidly expanding onto the continental slope. Selected target sites around the North Atlantic margin are recommended for synoptic exploration using standardized methods (particularly multibeam sonar mapping and ROV video transects). While recent studies have begun to document the deep Atlantic continental margins, most of the Atlantic margin remains to be explored. For example, numerous seamounts and topographic irregularities have been recently identified, but not visited, in the Atlantic Basin. The attached map of trans-Atlantic target sites illustrates areas where known vulnerable and important benthic habitats occur (e.g., deep-sea corals, sponges, canyons) as well as areas for exploration that are likely to yield significant new data. A Trans-Atlantic "transect" to be sampled would include a subset of partially explored and unexplored sites on both sides and near the center of the North Atlantic Ocean, covering a wide diversity of faunal and habitat types. This broad study area has shared species and habitats on both sides of the Atlantic (e.g., deep-sea corals and fishes) as well as species which do not overlap. Potential changing circulation patterns (e.g., Gulf Stream interruption), increasing temperatures, lowered surface salinities, and ocean acidification coupled with increasing resource exploitation all combine to suggest future impacts to North Atlantic deep ecosystems may be severe. Yet without adequate data, much of which is completely missing, such impacts are difficult to assess.

Brief Summary of what is known

The continental margin (200-2000 m) of the North Atlantic Ocean has been the subject of several recent studies, especially by the European community (e.g., ECOMARGE, HERMES, HERMIONE), focused on selected ecosystems (e.g., deep-sea corals, canyons, seeps). There now exists a baseline of data from which to compare new data temporally and spatially; however, previous study sites are scattered and represent a small portion of the continental slope. In addition, while some fauna (such as fishes) and

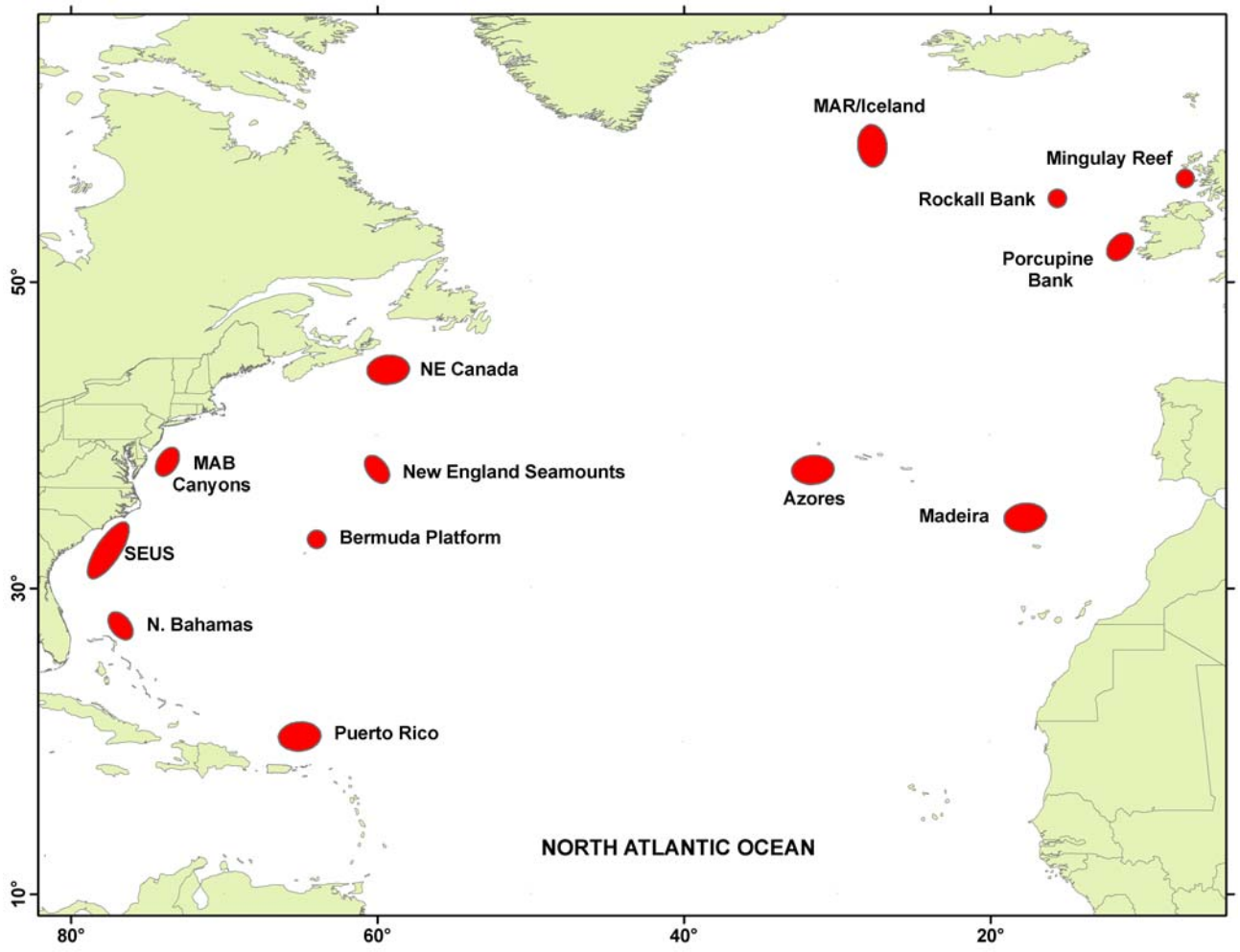
habitats (such as deep-sea corals) are relatively well documented, most fauna, particularly if not of economic importance, are very poorly known. Many of the studies on both sides of the Atlantic have focused on regional geology questions with a reasonable degree of comparability among studies. But, biological studies involving direct observations have lagged behind, and most biological studies are from different time periods (preventing a synoptic large scale data analysis) and used a wide range of methods. Lack of methodological standardization and lack of similar temporal sampling has restricted large scale interpretations of biological data. Mapping of bottom topography (mostly using multibeam sonar), while expanding, remains a critical need with most of the continental slope being unmapped (especially off the USA and developing or small countries). Detailed habitat typing and mapping as a companion to multibeam topographic mapping is even more restricted. The Irish continental shelf and slope are well mapped but represent a small region, while off the east coast of the USA similar mapping is represented by surveys of small areas often acquired without a standardized approach.

Rational for Exploration

One of the foundation concepts of the Trans-Atlantic Coral Ecosystem Study (TRACES, see http://www.lophelia.org/traces) is to conduct standardized sampling across an ocean basin scale region in order to resolve scientific objectives and hypotheses that are of common interest throughout the North Atlantic Ocean. While TRACES is focused on cold-water corals because they are a dominant continental margin habitat throughout the North Atlantic, other major features (submarine canyons, rocky reefs, sponge beds) share the TRACES concept and are good candidates for a basin wide approach. Comparisons of faunal community structure and habitat utilization for the same and different species at an ocean basin scale will facilitate understanding the ecosystem drivers. Although scientists throughout the Atlantic have common interest in the above deep-water habitats and have made major contributions to our understanding of such habitats, progress has been slowed by a lack of synoptic and standardized sampling. For example, the fish communities of cold-water coral habitats have been described for the northeastern Atlantic and off the southeastern US, but these data sets are not quantitatively comparable. Very large observed differences in how these fishes use the habitats in different regions cannot be well explained. Exploitation of continental margins is accelerating, and very often data are lacking to evaluate the impacts of such expansions. Increased knowledge about habitat types and extent of coverage and faunal associations will greatly improve the ability to manage these resources and will provide information necessary for large scale planning of Marine Protected Areas or other managed areas. More insidious impacts from climate change and ocean acidification also threaten Atlantic margin ecosystems, but without baseline data such potential impacts cannot be addressed.

Objectives:

- Produce detailed multibeam sonar bathymetry (where lacking) and habitat maps (combining video data) of selected target study sites across the North Atlantic Ocean.
- Conduct standardized underwater ROV video transects across selected trans-Atlantic sites.
- Collect additional benthic and water column physical data (CTD, aragonite saturation, dissolved oxygen) to correlate with video observations.
- Provide data in real time to multi-disciplinary collaborators in participating countries (UK, Ireland, Netherlands, Canada, Bermuda, USA).
- Conduct real time education and outreach via participating collaborators (e.g., NC Museum of Natural Sciences) and NOAA OER.



North Atlantic Ocean illustrating potential continental margin target sites for Trans-Atlantic explorations using standardized methods. Some parts of these sites have been explored and will be very useful as study anchor points for cross ocean comparisons, but there are large areas around these sites that have not been explored and will yield new habitat and fauna data.

Target Name : Mid-Atlantic Outer Continental Shelf

Why this area may be of interest

Biology - Secondary: Observe shipwrecks as reefs and essential fish habitat
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology - Discover historic shipwrecks utilizing commercial fishers knowledge
Other -

Contact Information

Ms. Joyce Steinmetz
East Carolina University
steinmetzj07@students.ecu.edu
(252) 864-5777

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-**Yes**	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-**Yes**	East. South Atlan.-

Brief Overview of Area

The Global Issue

Derelict commercial fishing gear litters ocean shipwrecks, resulting in economic hardship for fishermen, indiscriminate ghost fishing, destruction of essential fish habitat, marine debris, and loss of structural integrity and historical context of non-renewable cultural resources. Ocean explorers have discovered derelict nets and dredges on shipwrecks in the Baltic, Irish Sea, Mediterranean, Southeast Asia, Australia, and United States (Corkill 2009, Delgado 2008, Flecker 2002, Foley 2007, Hagberg 2009, Harris 2007, NMS 2008). Two regional landscape studies are complete on commercial fishing impacts to shipwrecks: the English Channel and the U.S. mid-Atlantic coast. In the English Channel, 42% of shipwrecks (115/247) display impacts of trawl nets and scallop dredges (Kingsley 2009).

Brief Summary of what is known

U.S. Research

On the U.S. mid-Atlantic coast, the author's M.A. thesis found 69% of a 52-wreck sample has 1 to 5 large derelict trawl nets and scallop dredges on-site. Combining fishermen and diver observations confirmed that 2-ton scallop dredges and 10-ton clam dredges pull through wood wrecks, extracting timbers and vessel contents. Off the Delmarva coast, three rotational-access scallop areas concentrate fishing impacts on shipwrecks. Detailed in twelve shipwreck case studies, site formation processes include deposition, scrambling, and extraction (Steinmetz 2010). Stellwagen Bank National Marine Sanctuary determined the largest threat to their submerged cultural heritage is commercial fishing. Maritime heritage on the U.S. outer continental shelf is inadvertently under attack.

Most fishermen try to avoid bottom obstructions and believe accurate locations are required to avoid collisions. The risk of gear loss is particularly high for scallopers on metal wrecks and for netters on metal and wood wrecks. Gear replacement cost is $10,000 to $50,000 per system. In the past 25 years, $76M of gear has been lost between the Hague Line and Cape Hatteras. Despite advanced technologies, such as

hang books, global positioning systems, and chart plotters, diver observations confirm that fishermen continue to lose gear and damage maritime heritage (Steinmetz 2010).

Rational for Exploration
Proposal

This dissertation research proposal seeks local fisheries knowledge (LFK) (NOAA 2007) to formulate cultural resource management solutions.

1. First, the author will continue to interview commercial bottom fishermen about "minimum exclusion zones to prevent impacts to maritime heritage" and "whether notification of maritime heritage resource site locations will reduce gear impacts" (NMSP 2010d).

2. Second, utilizing fishermen's hangs and diver wreck locations, the author will develop a geographic information system (GIS) predictive model to locate potential historic shipwrecks target areas. Geographically plotting fishermen's hang numbers generates many clusters, with and without diver confirmed wreck numbers. Geo-referencing and layering the fishermen's data to the diver's data on known wrecks may yield a predictor formula for discovering shipwrecks.

3. Third, utilizing vessel time and remote sensing equipment, the finite target areas can be field-validated in Stellwagen Bank National Marine Sanctuary (NMS) and the mid-Atlantic limited-access scallop areas, designated by NOAA's National Marine Fisheries Service. The New England and mid-Atlantic field surveys can be compared for efficiency and reliability against each other and against traditional 100% coverage side-scan sonar, magnetometer, and multi-beam surveying.

This research is in the initial planning and data-gathering phase. The author will renew her Institutional Review Board approval for interviewing fishermen. A GIS template is currently in progress. Three experienced fishermen have donated their hang datasets for analysis; one set has over 19,000 records. From the mid-Atlantic diving community, the author has 175 confirmed wreck locations. Budgets and timelines are the next step to a formal dissertation proposal and grant funding. Key partners are the Bureau of Ocean Energy Management Regulation and Enforcement, National Marine Fisheries Service, and Mid-Atlantic and New England Fisheries Management Councils.

Analysis could provide a validated efficient model to predict obstruction locations from inaccurate fishermen hang clusters and a predictor of fishermen behavior if given accurate obstruction locations. This multi-user proposal, combining maritime archaeology, technology, and the local knowledge bases of the fishing and diving communities, seeks to provide commercial fishermen with the tools to avoid damaging or losing bottom gear while preserving essential fish habitat and safeguarding non-renewal underwater cultural resources. Discovery and exploration of historic shipwrecks awaits!

Thank you for your time and consideration. I am available 9-10 May 2011 for the discussion workshop.

Joyce H. Steinmetz
Ph.D. Student, Coastal Resources Management, East Carolina University
M.A. Nautical Archaeology and Maritime History, East Carolina University
B.S. Mechanical Engineering, Pennsylvania State University
B.S. Industrial Engineering, Pennsylvania State University

References cited upon request.

Target Name : New England Continental Margin: Shelf Edge Canyons

Why this area may be of interest

Biology - X
Geology - X
Chemical Oceanography - X
Physical Oceanography - X
Marine Archaeology - X
Other -

Contact Information

Daniel Brothers, Garreth Lawson, and Kurt Schwehr
USGS, WHOI, CCOM
dbrothers@usgs.gov
508-457-2293

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.- **Yes**	North.Mid-Atlan.-**Yes**	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Submarine canyons along the New England continental margin represent some of the most intriguing geomorphic features of the entire US Atlantic margin. Here, numerous canyons create seafloor relief of several hundred meters and form complex channel networks resembling onshore fluvial systems (see attached figure). Several canyons extend landward from the shelf break for tens of kilometers and appear to capture along-shelf current driven transport of sediment. This region is also home to numerous top predator species, including marine mammals, seabirds, and fishes. Submarine canyons of the New England margin are recognized as having strong influence on modern-day and ancient geological, biological and oceanographic processes.

Brief Summary of what is known

Understanding physical and biological processes at the shelf-edge is a frontier research theme in the marine sciences. Most of the margin deeper than the 1000m isobath has been mapped using multibeam bathymetry. We know the location of major canyon systems and the geomorphic expression along much of the slope and rise. Sedimentary bedforms and benthic sea life have been observed in a few of the canyons during Alvin dives. Acoustic mapping and sediment sampling of the outer shelf suggests canyons are genetically linked to glacial cycles and outwash events but continue to be active during sea level high-stand. Mooring arrays and autonomous current profilers have measured robust shelf-slope water exchange in and around canyons off New England. The heads of the submarine canyons are sites of particularly high abundances of shelf break-associated predators, and intense commercial fishing activity. Community interests in understanding such processes provided partial motivation for the Pioneer Array of the Ocean Observatories Initiative (see figure). Finally, numerous shipwrecks and archeological sites are located in the region (see map).

Rational for Exploration

We aim to explore two fundamental questions: how do submarine canyons form and why are canyons 'hotspots' of biological activity? A large percentage of the total sediment transport and oceanographic exchange occurs in the vicinity of shelf-indenting canyon heads. Canyons are the primary transport pathways for terrigenous sediment that reaches the abyssal sea. Yet our understanding of canyon formation is limited due to an absence of focused exploration at canyon heads. The biological and physical factors that make shelf-break canyons favorable habitat for top predators remain poorly understood, but likely relate to the retention of lower trophic levels, notably zooplankton and micronekton. Our seagoing objectives are two-fold: (1) acquire high-resolution bathymetry of New England canyon heads (e.g., Okeanus Explorer surveys) in order to understand canyon erosion and how various sediment transport mechanisms are manifested in the morphology of canyon thalwags and channel networks. (2) Perform water column sampling for zooplankton and micronekton using towed multi-frequency and broadband acoustics and profiled image-forming optical systems. These additional data will allow us to apply quantitative tools to study linkages between seafloor morphology, boundary-layer currents, and sea life. We aim to explore mechanisms leading to the aggregation in canyons of zooplankton and micronekton, the interaction of these organisms with higher predators, and effects of inter-annual variability due to modulation by Gulf Stream warm-core rings.

Finally, as shown in the attached map, there are a number of known shipwrecks suggesting potential overlap between our proposed mapping of submarine canyons and archeological targets in the region.

Target Name : Norfolk Canyon Area Outer Continental Shelf LGM Coastline

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology - (X) Drowned Paleolithic Human Occupation and Pleistocene Vertebrate Sites
Other -

Contact Information

Dr. Darrin Lowery
Smithsonian Institution, Dept. of Anthropology; and University of Delaware, Dept. of Geography
darrinlowery@yahoo.com
410-822-4737

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-**Yes**	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-**Yes**	East. South Atlan.-

Brief Overview of Area

The Norfolk canyon off the Middle Atlantic outer continental shelf represents the last glacial maximum estuarine outlet of the low sea stand Susquehanna River drainway. Because of post-Pleistocene marine transgression infilling, the LGM Susquehanna Valley pathway is hidden and buried. The bathymetric relief both north and south of the Norfolk Canyon area indicates the presence of LGM-age barrier island platforms and associated barrier island lagoons. For the period of maximum low sea stand circa 20,000 to 25,000 years ago, no relative sea level benchmarks exist for the region. Data for the region indicate that relative sea levels were between -75 to -78 meters below present just prior to meltwater pulse 1A circa 14,600 years ago.

Brief Summary of what is known

In 1970, the deep-sea scalloping vessel Cinmar exhumed a virtually complete mastodon skull and a large bi-pointed rhyolite knife from -74 meters below the ocean immediately south of the Norfolk Canyon. The crews on many scalloping vessels have reported clusters of large bones as “snags” on the bottom. Additional Pleistocene vertebrate remains have been reportedly dredged from the outer continental shelf for many years and many of these are in the collections of the Smithsonian Institution. Along with freshwater peat unearthed from the bottom, the single human artifact and the various vertebrate remains found near the Norfolk Canyon suggest a coastal freshwater oasis may have existed at the time of last glacial maximum. The geochemical patination observed on the large bi-pointed rhyolite knife and the depth of discovery would imply that it is at least 14,500 years old or 1,500 years older than the Clovis culture in North America. Importantly, the associated mastodon skull was radiometrically-dated to ~22,000 years old indicating that the knife may represent a LGM human occupation of the Middle Atlantic outer continental shelf.

Rational for Exploration

Plans for offshore “wind farms” and natural gas and oil drilling have been proposed for the Middle Atlantic continental shelf. The Cinmar discovery suggests that pre-Clovis (>13,000 years old) human occupation sites exist on the outer continental shelf of the Middle Atlantic. Presumably, these Paleolithic sites may have been oriented towards coastal resources. Given the data already in hand, an investigation of the Norfolk Canyon area would provide a protocol for investigating documented inundated terrestrial Paleolithic archaeological sites on the outer continental shelf before occurrence of “wind farm” construction and offshore drilling. The research would potentially provide high resolution relative sea level data for the region. The results of the exploration could also provide detailed paleo-ecological proxies for late Pleistocene coastal environments immediately south of the LGM Laurentide ice sheet terminus. Importantly, the research could add significant information relative to the debate surrounding the initial prehistoric colonization of the New World.

A paper highlighting the Cinmar discovery has been submitted to SCIENCE for publication. I will be available on May 9th and 10th, 2011 for the workshop if selected as one of the participants.

Target Name : Telegraph Axial Volcano, Mid-Atlantic Ridge

Why this area may be of interest

Biology -
Geology - expplore nature incl ? vents/recent activity. of 2 km tall axial volcano and ? off-axis trace
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Peter Vogt
Marine Science Inst.
Univ. of California at Santa Barbara
ptr_vogt@yahoo.com
410-586-0067k

Willing to attend?

General Region of Field Operations

Gulf of Mexico-Caribbean Sea-	West. North Atlan.-	North.Mid-Atlan.-**Yes**	East. North Atlan.-
	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

We propose systematic OER exploration of an EW crustal band on the northern MAR, centered on 2 km high Telegraph Axial Volcano (TAV,ca.48.3N, see locator map) but extending to ca. 5-10 Ma crust on Eurasian and North American plates,diverging there at 22 mm/a. The axial volcano rises (counterintuitively) from the presumably relatively magma-poor regional topographic saddle between Iceland and the Azores-- both of which long attributed to some type of mantle melting anomaly or plume. The 47-51N section of the Mid-Atlantic Ridge was early recognized as segmented into wide-angle southward-pointing V-shaped topographic bands of alternately shallower and deeper terrain.

After high speed mapping of this cross-axis band, the TAV itself and adjacent rift valley and rift mts would be explored, especially for recent volcanism, faulting, and hydrothermal activity.

Brief Summary of what is known

The 47-49N part of the Mid-Atlantic Ridge (like large parts of the North Atlantic and central and western North Pacific) was surveyed in the 1960s by the Naval Oceanographic Office, using the early SASS multibeam system. This mapping (nearly a half century ago) predated both GPS and the recording of full multibeam returns, limiting navigational accuracy and precluding processing for side-scan imagery. Moreover, no magnetic or sediment profiler data were collected. Smoothed versions of this early bathymetry have long been incorporated into public bathymetric data grids, and a hand-smoothed 100 fm contour map of TAV itself was released by C. Smoot ca. 1990 (modified as Fig. 4, Vogt and Jung, GSA Special Paper 388, 2005). However, even the raw data, should they ever be released, are now far from state-of-art, but serve for reconnaissance purposes. Other than a handful of old rock dredges--which suggest but do not prove slight REE enrichment--this part of the MAR remains essentially unexplored. We only know the axis is regionally oblique, broken into alternately normal and strongly oblique segments, with possible short-offset transforms.

Rational for Exploration

The origin of widely scattered tall (>1 km relief above adjacent plate boundary/rift valley floor) axial volcanoes, known only at rates <60 mm/a (mostly <40 mm/a), remains a mystery. The location of TAV in the saddle between Iceland and the Azores suggests that some process other than 'traditional hotspots' is at work. Is the location of TAV in the saddle a coincidence or not? Is the robust magmatism that has created TAV a long-term feature of the local plate boundary? If so, accurate off-axis multibeam bathymetry may reveal some off-axis 'trace' of past axial volcanism, tectonically 'butchered' upon export from the rift axis and valley faults. Does any off-axis volcano-tectonic activity occur east or west of TAV, i.e., activity younger than the crust? The 2-km high TAV fills the rift valley , so volcanism must be ca. <1 Ma. But have there been very recent eruptions as well? A site of active volcanism has yet to be discovered along slow-spreading ridges (other than Iceland): TAV is a good place to prospect for such activity. Mapping the TAV could be the basis for future placement of long-term hydrophone recording stations--which might record along-axis magma transport as known from Iceland. Teleseismic activity has been low near TAV, suggesting magma-dominated spreading, more like the EPR. TAV rock composition is unknown save for two 1970s dredges. TAV may host hydrothermal vents/chemosynthetic oases, helping fill the long gap between Iceland and the Azores, elucidating dispersal and colonization of biota.

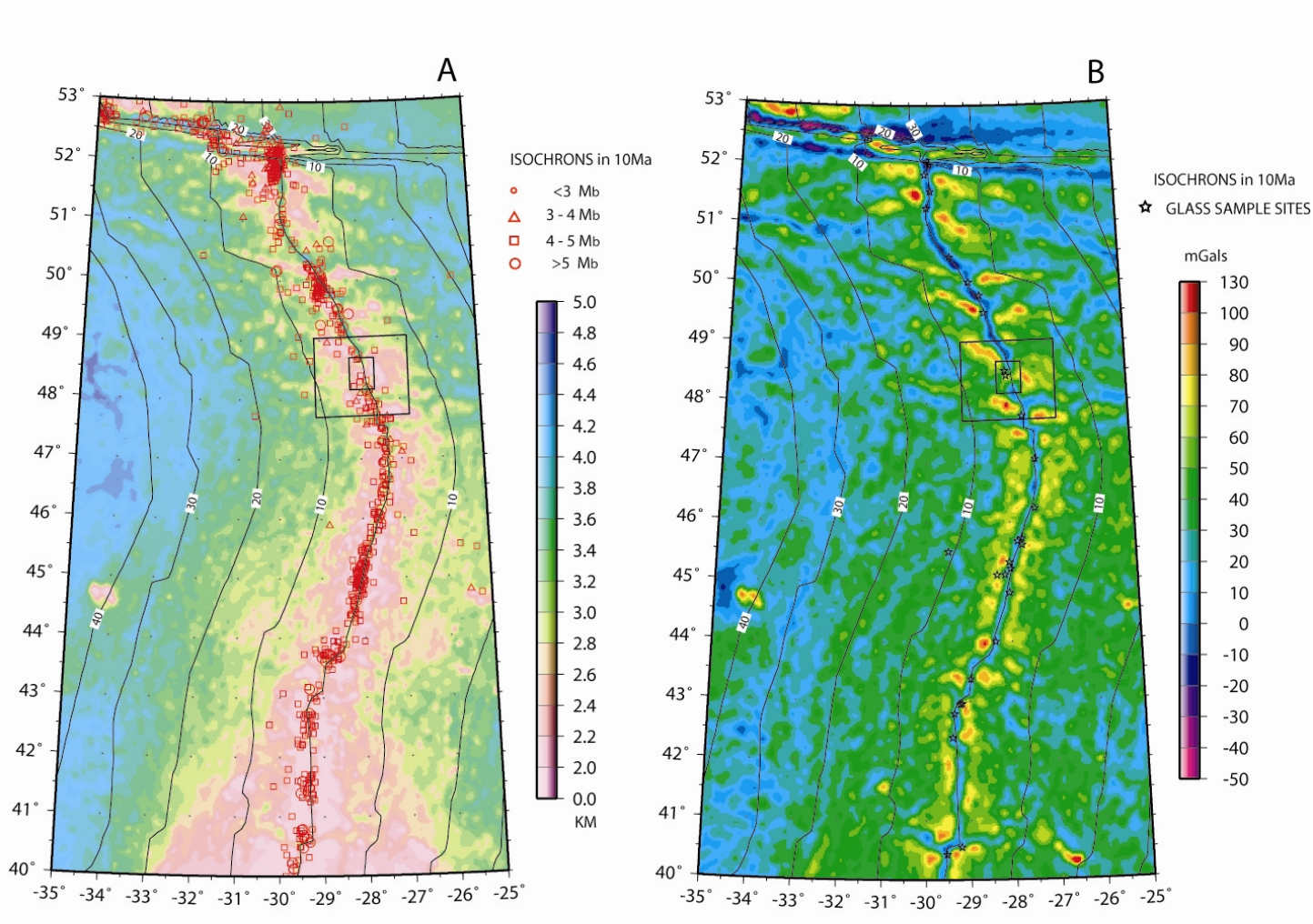


Fig.1: (A) MAR water depths (Smith and Sandwell, 1997), earth quake epicenters (National Earthquake Information Center), crustal isochrons (Mueller et al., 1997), and present plate boundary (modified from Vogt, 1986).Large box is proposed investigation area, small box detailed TAV bathymetry (Fig. 2B); (B) Free-Air gravity anomaly map of same area (Smith and Sandwell, 1997) and basalt glass samples in Smithsonian database; other information as in (A).

Target Name : Equatorial Mid-Atlantic Ridge (12N-4S)

Why this area may be of interest

Biology - hydrothermal venting associated with long-lived (detachment) faults
Geology - formation of detachment faults and exposure of lower crust and mantle rocks on the seafloor
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Deborah Smith
Woods Hole Oceanographic Institution
dsmith@whoi.edu
508-289-2472

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-**Yes**	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-**Yes**	East. South Atlan.-

Brief Overview of Area

The Equatorial Atlantic is especially interesting because of its tectonic history associated with the opening of the Atlantic Ocean. A strongly segmented Mid-Atlantic Ridge (MAR) is offset on some of the longest transform faults in the oceans (e.g., > 900 km Romanche transform). Offsets are especially large between about 3N and 3S, where the cumulative length of the transforms is longer than the cumulative length of the ridge axis. The fracture zones have extreme topographic relief and are important conduits for bottom water moving between the N and S Atlantic, and likely act as physical barriers blocking the transport of hydrothermal vent fauna along the ridge axis. At this time there is only limited bathymetric coverage of the MAR and its flanks south of about 12N and much to be learned about accretion processes in this part of the Atlantic.

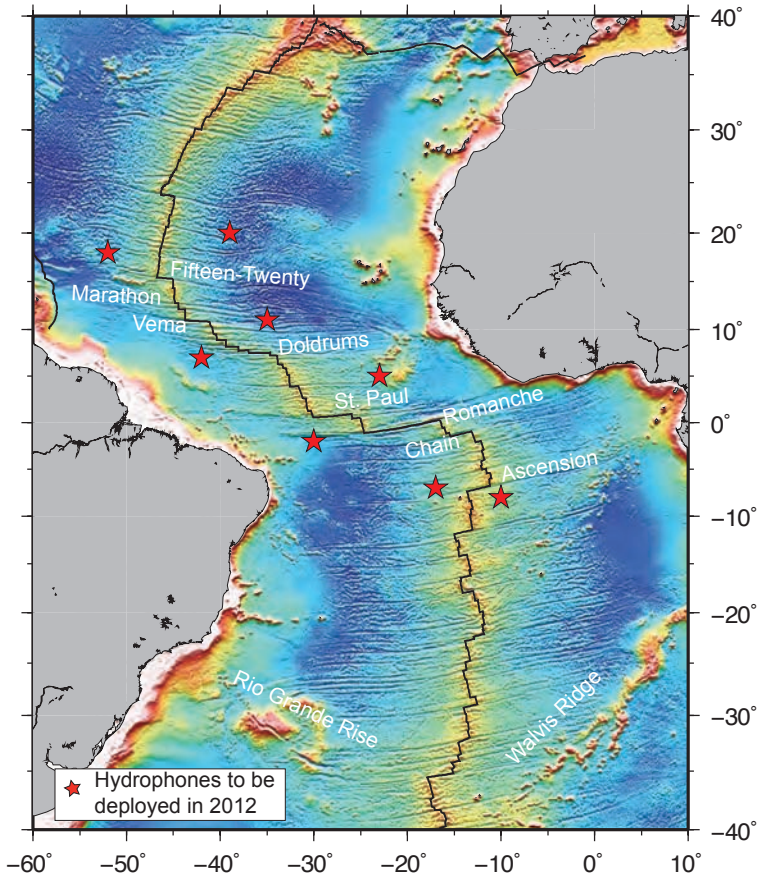
Brief Summary of what is known

Multibeam data collected in the 1980s and 1990s primarily cover the fracture zones as they have been the subject of most of the studies. These include the Vema, Romanche and Chain fracture zones. A survey near the Four North fracture zone in the mid-1980s on the R/V Robert Conrad mapped the MAR north and south of the fracture zone. There has also been a more recent study in the 4-5S region studying the character of hydrothermal venting there. In other areas of the MAR south of 12 N (the Marathon fracture zone) and north of 4S there are little data, perhaps a single track along the axis in places, according to data archived at NGDC and the Marine Geoscience Data System site at Lamont Doherty Earth Observatory.

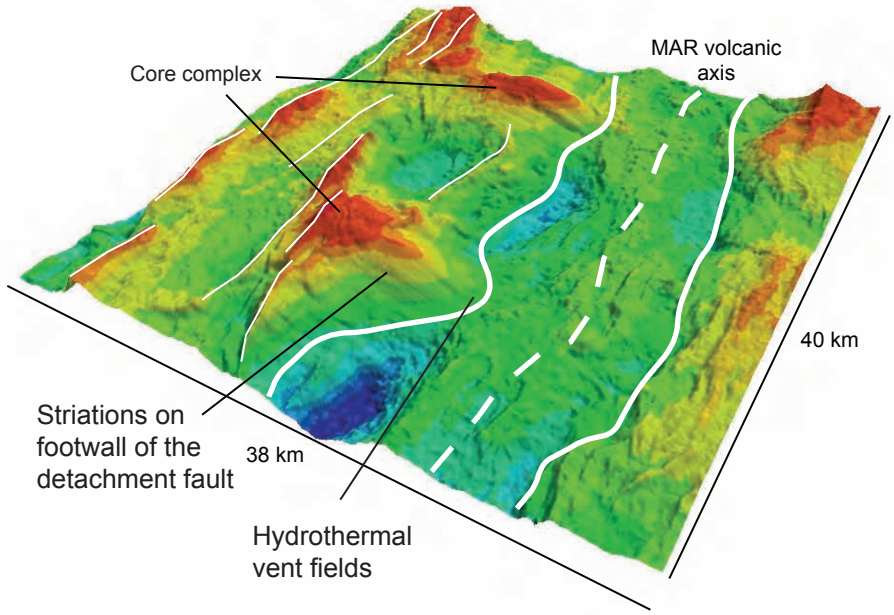
Rational for Exploration

Over the last few years it has been recognized that there are two, not one, primary modes of magmatic accretion at slow spreading ocean ridges: symmetric and asymmetric spreading. Symmetric spreading is characterized by magmatic diking, short-offset high-angle faulting, and the formation of linear, ridge-parallel abyssal hills on both flanks. Asymmetric spreading differs significantly from this in that long-lived faults (detachment faults) unroof lower ocean crust and mantle on one flank of the axis, while the volcanic section is spread away in the opposite direction. Known hydrothermal activity is closely associated with asymmetrical accretion, and almost all areas of asymmetrical spreading have high levels of hydroacoustically-recorded seismicity. We now understand that detachment faults, involving significant rotation and the formation of core complexes are common, account for close to 50% of the extension along 2500 km of the northern MAR (12-35oN). Also, asymmetric spreading may dominate for many millions of years producing fields of core complexes off axis. Not only does asymmetric spreading allow the architecture of the lower ocean crust and upper mantle to be examined, but it also changes the way in which we think about the very composition and structure of ocean crust, fluid flow, and hydrothermal venting and the ecosystems they support.

Does asymmetric spreading play an important role at the MAR south of about 12N? We expect that detachment faulting will be important in this region because of the thicker and colder than normal oceanic lithosphere and inferred mantle thermal minimum in the Equatorial Atlantic. Also of interest is whether the pattern of accretion changes across the long-offset Romanche transform, which likely separates geochemically distinct regions of the Atlantic. Obtaining multibeam bathymetry at the axis of the MAR and on to its flanks between 12N-4S is the critical next step. The bathymetry will lead to finer scale studies of individual features, including hydrothermal vents associated with detachment faults and sampling of deeper crust and mantle rocks exhumed during detachment faulting. Obtaining bathymetry data will also nicely complement an NSF funded proposal of D. Smith and R. Dziak (NOAA/PMEL) to record seismicity in the Equatorial Atlantic on moored hydrophones in 2012 and 2013.



Bathymetry of the Atlantic Ocean. Black line: axis of the Mid-Atlantic Ridge. Fracture zones in the Equatorial Atlantic are labeled. Red stars: locations of proposed hydrophone moorings in the Equatorial Atlantic to be deployed in 2012. Intense hydroacoustic seismicity has been associated with active long-lived faults in the North Atlantic (12-25N). Swath bathymetry data will provide new insight into the poorly understood accretionary processes in this region, especially in regions of intense hydroacoustic seismicity.



Detachment faults and associated core complexes on the west side of the MAR near 13N. This asymmetric spreading allows the architecture of the lower ocean crust and upper mantle to be examined, and it has changed the way in which we think about the composition and structure of ocean crust, fluid flow, and hydrothermal venting and the ecosystems its supports. It is not known if asymmetric spreading is common in the Equatorial Atlantic.

Target Name : Mid-Atlantic Ridge and seamounts in the Azores area

Why this area may be of interest

Biology - Cold water corals, sponges, and other seamount fauna
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Bradley Stevens
University of Maryland Eastern Shore
bgstevens@umes.edu
410-651-6066

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.- **Yes**
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

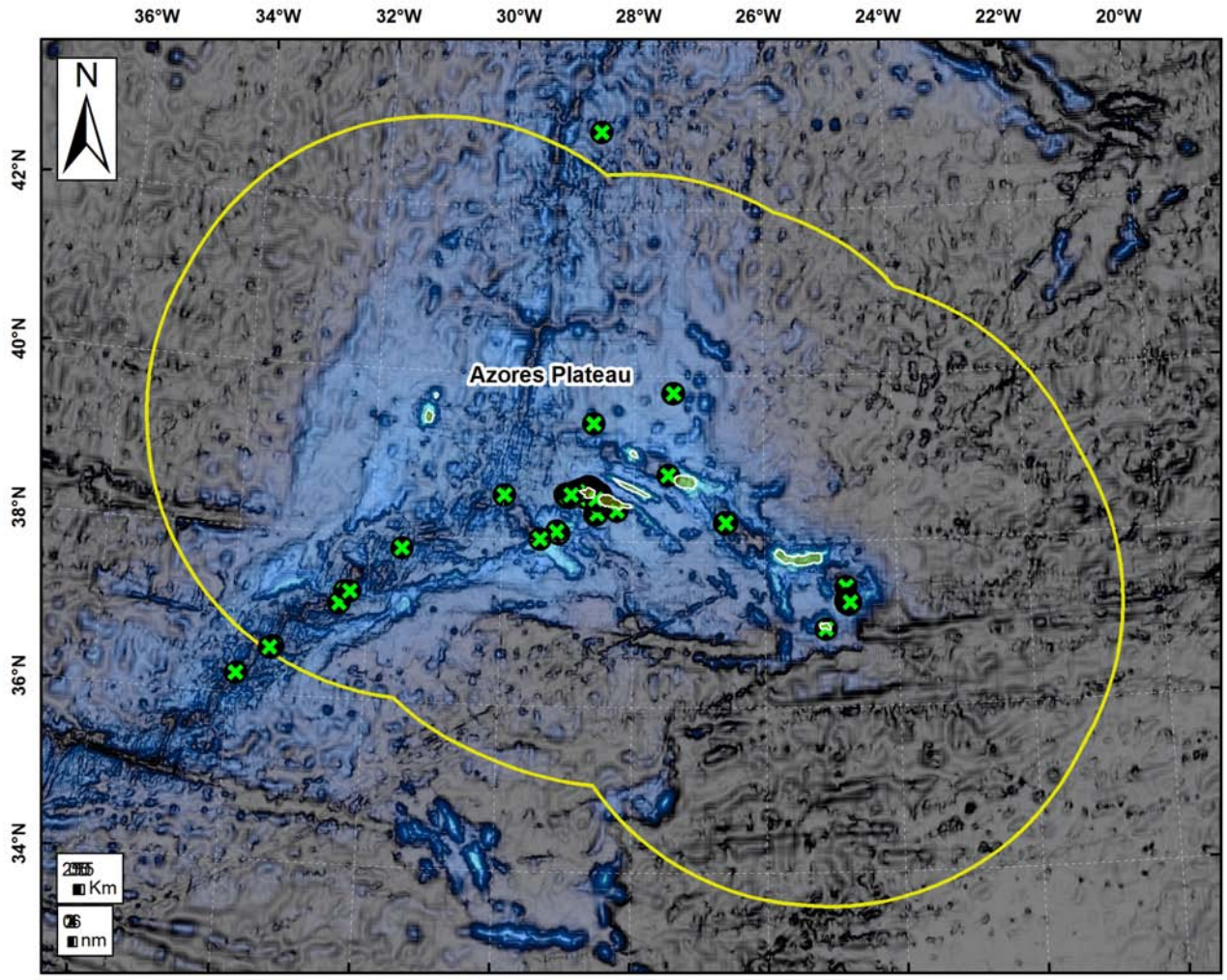
The Azores archipelago (36-40ºN, 24-32ºW) is located in the Mid North Atlantic 1,800 nm from Rhode Island and 1,000 nm from Portugal. The plateau from which the islands rise has an average depth of 2,000m and is located at the triple junction of three major plates, It has an EEZ of 1 million km2 including a portion of the Mid Atlantic Ridge, nine islands, at least 63 large and 398 small seamounts. The Azores are strongly influenced by the Gulf Stream western boundary current, which transports warm water of equatorial and tropical origin into the colder northern regions. The complex topography produces oceanographic phenomena such as jets or trapping currents around seamounts and upwelling that supports increased levels of biodiversity. The Azores are a biodiversity hotspot, harboring a vast array of species and habitats including coastal and offshore pelagic environments, island slopes, seamounts, cold water coral “reefs”, abyssal plains and hydrothermal vents.

Brief Summary of what is known

Deep-water hydrothermal vents in the vicinity of the Azores have been studied since 1992, but neighboring environments remained largely unexplored and more recently revealed exhuberant coral and sponge assemblages. Due to limited investment in widespread surveys, the distribution of non-vent fauna in the Azores is poorly known and is mainly derived from historical records, museum collections, anecdotal reports and records from a number of scientific surveys. An integrated survey of cold-water coral habitats using modern acoustic mapping and sampling technology is greatly needed. Multibeam and sidescan surveys have been conducted on few seamounts and submarine ridges around the central islands. Recent surveys have revealed large, dense gorgonian stands and the existence of cold-water Lophelia pertusa coral reefs, emphasizing the need for a more exhaustive exploration of deep-sea benthic communities in Azores seamounts.

Rational for Exploration

The Azorean deep-sea habitats, namely seamounts, are of great interest for exploration due to their remote oceanic location, low levels of scientific exploration, historically low levels of fisheries disturbance, and the diversity of their marine fauna. There is great potential for discoveries of new hydrothermal vent fields, new cold water coral reef habitats, and even new species of invertebrates and fish. There is also high potential for discovering new seamounts or other geomorphologic features through detailed mapping. This project will be conducted jointly by an international team of scientists and students from the University of the Azores, the University of Maryland, and others.



Caribbean Sea Region

Target Name : Mid Cayman Rise

Why this area may be of interest

Biology - This is an area that is also of interest to geology, chemistry and astrobiology
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Christopher German
Woods Hole Oceanographic Institution
cgerman@whoi.edu
508-289-2853

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Mid Cayman Rise is the world's deepest and also slowest spreading Mid-Ocean Ridge. It hosts volcanic activity along the deep ridge-axis but also has ultramafic mantle rocks exposed along its rift-valley walls. The MCR has been mostly overlooked since the mid-1970's but was actually the first place on Earth where ultramafic rocks were first identified on the deep ocean floor (see article by Bob Ballard in National Geographic magazine, August 1976 - as a result of joint Alvin and Trieste dives there earlier that year).
A matter of months later, the first hydrothermal vents were discovered on the Galapagos Spreading Center and the Mid Cayman Rise had remained virtually completely overlooked ever since - until now.

Brief Summary of what is known

In October-November 2009, I led a NASA-funded cruise that conducted systematic CTD water column sampling throughout the length and breadth of the Mid Cayman Rise, designed to prospect for three different types of hydrothermal activity: "conventional" black smokers (high temperature vents with high metal contents and moderate methane); "Rainbow-like" black smokers (hosted in ultramafic rocks and exhibiting very high methane and hydrogen concentrations as well as high metals); "Lost City" like vents (also hosted in ultramafic rocks but emitting alkaline fluids that are rich in methane and hydrogen but devoid of metals).

Our results (published in PNAS in July 2010) revealed that we had located evidence for 4 different sites of venting in less than 100km along axis including one of each of the above styles of venting. The most "conventional" actually sits at 5000m making it the deepest (and perhaps hottest) vent yet known. But immediately adjacent, and probably of greater interest, are two shallower sites, at 2000-2500m depth, sitting on top of the Western rift-valley wall on what (as discussed at last year's Chapman Conference) almost certainly represents a low-angle detachment fault/oceanic core complex, exposing ultramafic rocks.

Rational for Exploration

The best possible reason to explore is that we know these vent-sites exist - indeed, our UK colleagues have even managed to photograph 2 of the 4 sites in a follow-on cruise - but nobody yet knows what animals are living at the sites and how they relate to vent-fauna elsewhere: will they be similar to Mid-Atlantic vent animals? Or Gulf of Mexico seep fauna? Or nearest-neighbour vent-animals on the Galapagos Spreading Center (where vent-exploration began) which was connected to the MCR by an open seaway up until about 5My ago (closing of the Isthmus of Panama). The sites are also interesting to geology/geochemistry/astro-biology because if they ARE hosted in ultramafic rocks (also still to be confirmed) then they have the potential to host abiotic organic synthesis and hence, in turn, represent an ideal natural laboratory for the future - much more readily accessible to US scientists than the Mid-Atlantic Ridge - for studying conditions relevant to the origins of life on Earth and investigating and developing methods for exploration for similar potentially life-hosting habitats elsewhere in our Solar System.

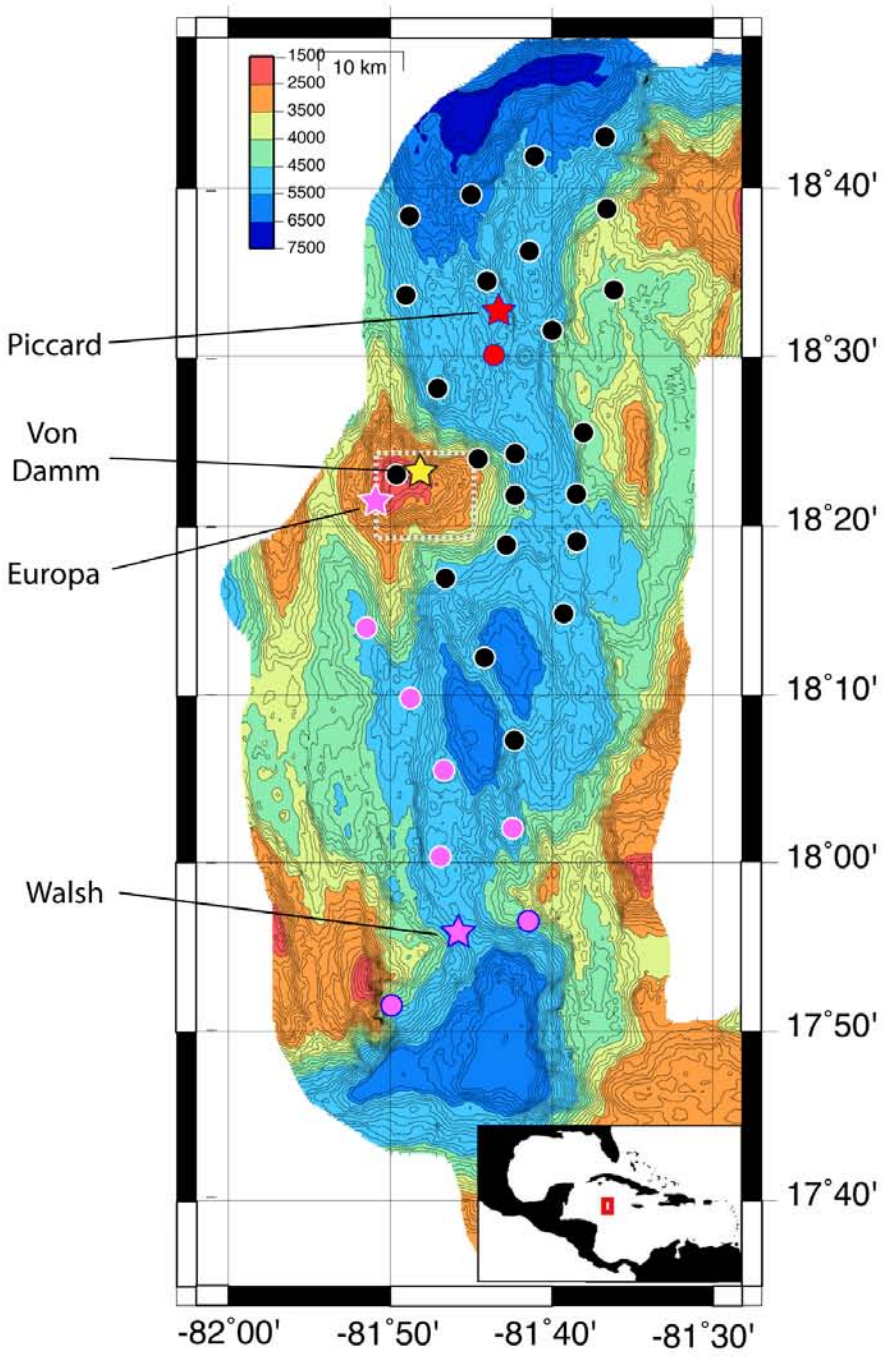


***Figure 1**: Map of the Mid Cayman Rise showing locations at which a suite of distinct styles of venting have been identified: Piccard: a deep (~5000m) basalt-hosted high-temperature system located toward the center of the axial rift -alley floor. Von Damm & Europa – shallow low-temperature systems atop Mt. Dent (an oceanic core complex that exposes peridotite-gabbro lithologies) Walsh – a deep (>4000m) ultramafic-hosted high-temperature system.*

Target Name : St. Eustatius and Saba Marine Parks

Why this area may be of interest

Biology - Two well protected and relatively pristine marine sanctuaries teeming with aquatic life

Geology - Many volcanic features (pinnacles, lava flows) including a possible volcanic cone southwest of St. Eustatius

Chemical Oceanography -

Physical Oceanography -

Marine Archaeology - There are an estimated 200 shipwrecks in the waters surrounding St. Eustatius.

Other -

Contact Information

Dr. Grant Gilmore
St. Eustatius Center for Archaeological Research, St. Eustatius National Parks, Saba National Parks
grant.gilmore@secar.org
+599 318 0066

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

St. Eustatius and Saba are Caribbean municipalities of the Netherlands, and are located on the inner, active volcanic arc of the Leeward Islands, south of St. Maarten and northwest of St. Kitts and Nevis. As there is no mass tourism on either of the islands, they are relatively unknown to the general public.
The St. Eustatius Marine Park was created in 1996 and extends around the entire island from the high water line to the 30 meter depth contour. The park covers an area of 27.5 km2 and protects a variety of habitats, including pristine coral reefs (drop off walls, volcanic 'fingers' and 'bombs', spur and groove systems), historical shipwrecks and modern-day artificial reefs.
The Saba Marine Park includes the waters surrounding Saba and part of the Saba Bank. Covering 1850 km2, Saba Bank is the largest coral atoll in the Atlantic Ocean Basin, and includes vast fields of corals which are relatively untouched by direct human impact. Saba Bank supports many reef and pelagic fish species, turtles, and birds.

Brief Summary of what is known

Archaeological research in St. Eustatius' Oranje Bay was first carried out in the 1980's. Most notably, the historical anchorage was located and two shipwrecks were investigated. More recently, a survey of various submerged cultural heritage sites in Oranje Bay, including a survey of all known cannon and anchors, was carried out. Much more work remains to be done, as historical research indicates many more shipwrecks await discovery. No maritime archaeological research has been carried out in the Saba marine park to date, although here too historical research indicates many submerged cultural heritage sites remain to be discovered.
The geology of St. Eustatius and Saba was first described in detail in the 1960's, although the earliest geological research in the area dates back to 1817. The most recent geological research focused on the volcanology of Saba and St. Eustatius. Although the terrestrial geology of both islands is for the most part well understood, submerged volcanic activity largely remains a mystery. A bathymetric chart made by the Royal Netherlands Navy showed a possible volcanic cone to the southwest of St. Eustatius, which

warrants further investigation. This chart, however, only covered the Caribbean side and provided little relevant information for biological or archaeological resource management.
Virtually no marine biological surveys have been conducted with the exception of annual 'reef check' transects, being run for the past few years by St. Eustatius National Parks. Recently, a turtle tracking project has been initiated as well. However, the underwater biota of St. Eustatius is in a relatively pristine state due to few commercial fishing impacts. The same goes for the Saba Marine Park and the Saba Bank.

Rational for Exploration
No previous research projects have addressed the interaction between geology, marine habitats (coral reefs, open sand, and sea grasses), shipwrecks, and humans on a volcanic island in the Lesser Antilles. Although populated with the same density as New York City during the later 1700s, St. Eustatius' economic collapse during the early 19th century has provided a biological, geological and archaeological time machine for scientists. Drastic population decline reduced human impacts on these resources to a bare minimum for the next two centuries. Furthermore, Saba has never had a large human population throughout its history. Therefore, historically, St. Eustatius and Saba have suffered far fewer detrimental environmental attacks from overpopulation, overfishing, overdevelopment and other environmental maladies affecting many other Caribbean Islands. Thus, on St. Eustatius and Saba, these resources are currently in a relatively pristine state that can provide a significant baseline measure for addressing projected significant human impacts here and elsewhere resulting from development, marine resource exploitation, and global warming.

Target Name : Eastern Caribbean: Windward Antilles region, Aves Escarpment, Grenada Plain

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Mr. John Reed
Harbor Branch Oceanographic Institute, Florida Atlantic University
jreed12@hboi.fau.edu
772-242-2205

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Eastern Caribbean: Guadaloupe to Grenadines and Barbados; deep hard-bottom habitat on deep island slopes to the Granada Plain, and including Loro Seamount, Aves Ridge, and Aves Escarpment.
16o 27'N, 62o 10' W to 12o 23'N, 63o 24'W, 300 m to 3000 m..

Brief Summary of what is known

Harbor Branch Oceanographic Institution using the Johnson-Sea-Link submersible conducted cruises in 1989 to explore and document the deep island slopes of the windward Antilles region to depths of 1000 m. No true deep sea coral reefs have been documented in this region but there is extensive hard-bottom providing potential habitat for coral, sponges, and black coral. During this expedition we also made the first known dive on Kick'em Jenny Volcano, northwest of Grenadines. NOAA's Ron Brown has made multibeam maps of the volcano and other areas of the region.

Rational for Exploration

Deep sea coral reef and hard-bottom ecosystems support vast amounts of the ocean's biodiversity and exhibit exceptional variation in relative forms, functions, origins, and locations. Relatively little is known about the deep sea hard bottom habitat in this region west of the windward islands. Ultimately the primary benefits are critical data that characterize the resources, habitat and ecosystem functions, ecosystem services, and, when applicable, the impact of management actions on these resources.

Target Name : Cayman Trough

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other - All of the above, minus Marine Archeology (to my knowledge)

Contact Information

Dr. Nicholas W. Hayman
University of Texas, Institute for Geophysics (Austin, TX)
hayman@ig.utexas.edu
512-471-7721

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Cayman Trough contains one of the deepest active seafloor spreading centers on Earth, spreading at some of the slowest spreading rates and generating some of the thinnest oceanic crust.relative to other accretionary plate boundaries. Comparable seafloor environments are in remote or even inaccessible locations in the Arctic and Southwest Indian Ocean. The crust surrounding the Cayman Trough includes deep arc terranes, edges of an Eocene-age rift, and serpentinized upper mantle material (which is also exhumed in the spreading center).

Brief Summary of what is known

Earth scientists focus on arc terranes to understand the evolution of the continents. They focus on rifts and spreading centers to understand extensional processes such as those that accrete ocean crust and define the continental margins. Serpentinization is of paramount interest because the process supports distinctive biological and chemical seafloor and subseafloor environments, and leads to a potential CO2-sink. Moreover, exploration of the Cayman Trough is important because it serves as a narrow seaway in global oceanographic circulation and it hosts a seafloor ecosystem that potentially evolved in geographic isolation of the global mid-ocean ridge and shelf environments.

Rational for Exploration

As reviewed by Hayman et al. (Geochemistry, Geophysics, Geosystems, 2011), work in the 1970's by Ballard and others illustrated the power of using human occupied vehicles and deeply towed cameras doing the initial exploration of the mid-Cayman Spreading Center (MCSC). However, that early work was overshadowed by the discovery of hydrothermal vents in the Pacific. Since then, several groups have conducted a variety of missions using dredging, sidescan sonar, remotely operated and autonomous vehicle, and geophysical techniques to tackle the Cayman Trough and surrounding environs. Challenging the limits of some ROV technology, parts of the Cayman Trough are >4000m. However, other parts reside well above these depths and are excellent targets for investigation or all technologies. Given the recent discovery of hydrothermal vents along the MCSC, new ecosystems both within the spreading center and transform and rifted margin edges are bound to be present. As an overall system the Cayman Trough should be considered as an exciting and diverse natural laboratory for Ocean Exploration opportunities.

Target Name : GONAVE BAY, HAITI

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Marie-Helene Cormier
University of Missouri - Columbia
cormierm@missouri.edu
(573) 882-8608

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-Caribbean Sea-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Gonave Bay is bracketed by Haiti's northern and southern peninsulas, and terminates eastward at Port-au-Prince. To the west, it opens up to the Windward Passage, a deep (1,680 m) gateway between the Atlantic and the Caribbean. It covers ~15,000 km2 and comprises basins, some as deep as 3,700 m, separated by shallow ridges. One ridge emerges as the 58 km-long Gonave Island. A shallow depression offshore Port-au-Prince is surrounded by a 35 m-deep platform. Coral reefs fringe most of the shorelines, and barrier reefs also occur. The devastating 2010 Haiti earthquake dramatically demonstrated that the Gonave microplate (a narrow plate wedged between the N. American and Caribbean plates that includes Gonave Bay) is tectonically active. This complex plate boundary controls the shoaling and deepening of northern Caribbean gateways and the growth or demise of coral reefs.

Brief Summary of what is known

Industry seismic reflection data collected in the 1980's in Gonave Bay image a system of fold-and-thrust belts and strike-slip faults that appear to be active. They also reveal some intriguing seafloor mounds as deep as 1,200 m. These have dimensions compatible with cold-water coral mounds, mud volcanoes, or drowned coral reefs. Gonave Bay had not been explored with modern geophysical method until 2010. A French team acquired a few bathymetric swaths through deep portions of the Bay immediately after the 2010 earthquake. Our REPONS team conducted a short cruise to investigate the underwater extension of the fault responsible for the earthquake. We mapped that fault close to shore and sampled fresh turbidites. We also mapped portions of the platform surrounding the shallow basin off Port-au-Prince, a survey that reveals spectacular dissolution structures 1-2 km across and ~80 m deep. We interpret these to be antecedent karst topography that developed during previous eustatic lowstands.

Rational for Exploration

Gonave Bay is a fascinating area to investigate the interplay between tectonics, sedimentation, bottom water circulation, climate change, and coral growth. To our knowledge, Gonave Bay has yet to be explored with deep-submergence technology. A comprehensive multibeam bathymetric coverage combined with the simultaneous acquisition of CHIRP seismic profiles would highlight the plan-view geometry of active faults, folds, and landslides, much-needed information for the assessment of seismic and tsunami hazards in Haiti. Seismic profiles show erosional surfaces near the crest of anticlines that are now in several 100s m-water depth, suggesting that the floor of Gonave Bay is regionally subsiding. High-resolution bathymetric mapping, sampling and dating of drowned reefs or shorelines would quantify rates of vertical deformation and provide insights into competing models for the 2010 earthquake rupture. The Windward Passage may be a key gateway for bottom waters from the Atlantic to the Caribbean, but little is known about its local impact. For example, if the deep-water mounds imaged with industry seismic are live cold-water corals, their occurrence may be controlled by bottom currents. US scientists are now collaborating with Haitian scientists and seek to invigorate this emerging collaboration. We are in contact with French and Spanish teams that recently proposed to carry out geophysical surveys offshore Hispaniola, and have mutually agreed to make new data available to each other for cruise planning purpose.

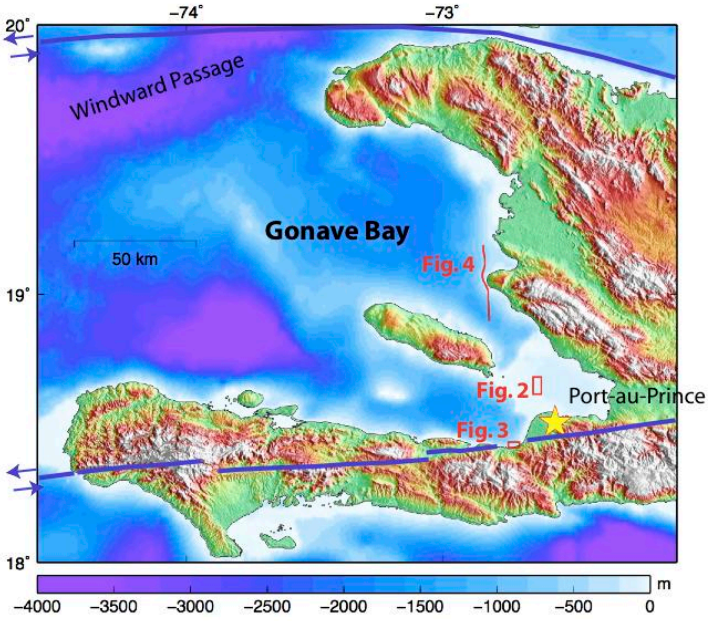
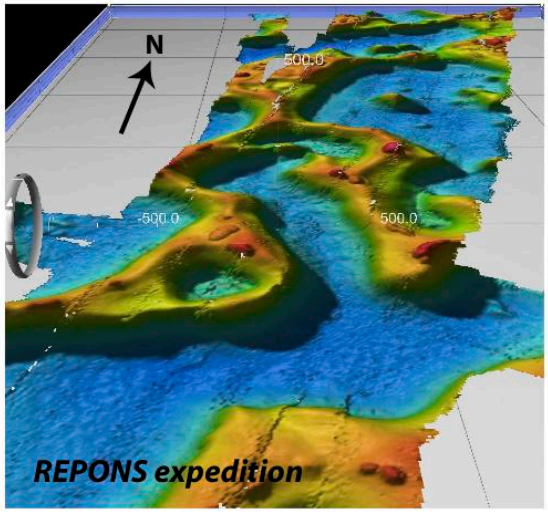
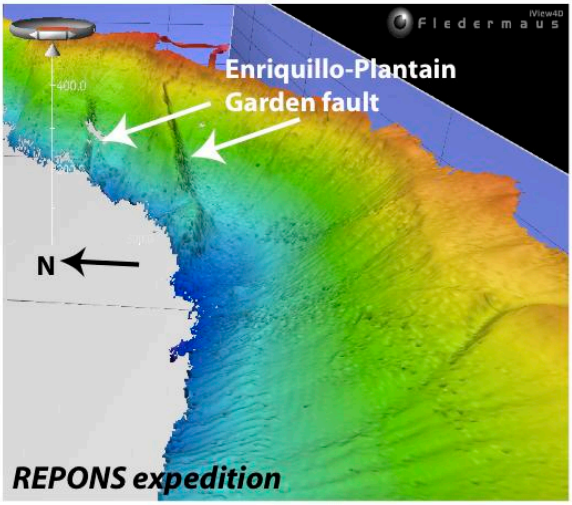


Fig. 1 (left). Gonave Bay (Haiti). Bathymetry from GEBCO. Star indicates epicenter of 2010 earthquake. Purple lines are transform faults that mark northern and southern boundaries of the Gonave microplate.

Fig. 2 (below left). Drowned karst topography off Port-au-Prince (located in Fig. 1). Top (reddish) is ~35m deep, and floor of dissolution structures (blue) is ~80 m deep.

Fig. 3 (below right). Offshore extension of earthquake fault mapped in 2010 along very steep slope (located in Fig. 1). Depths vary from 80 m to 350 m. V.E. = 2





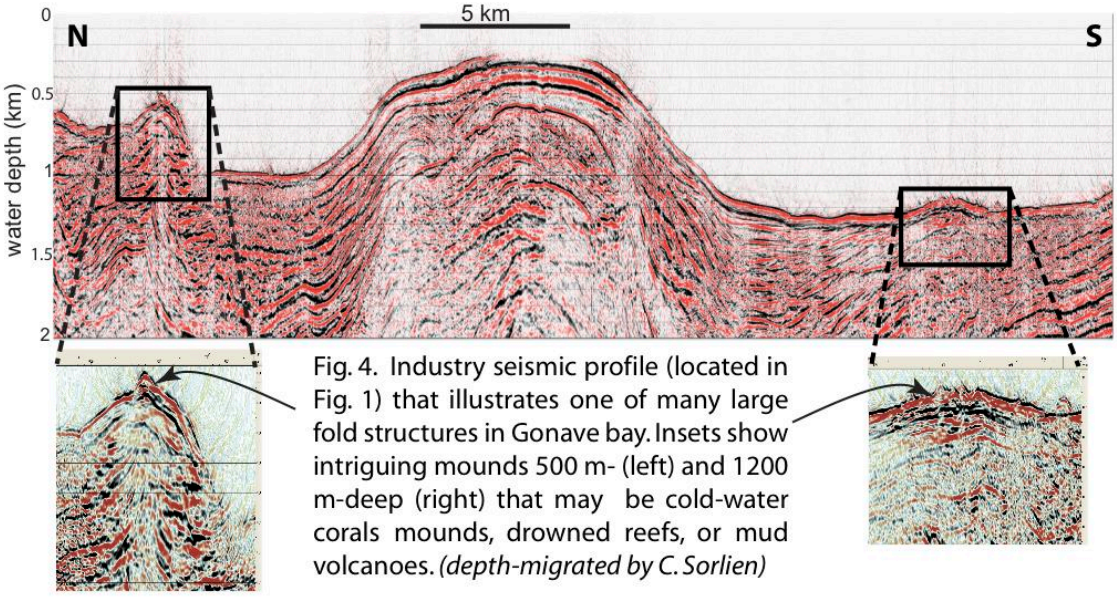


Fig. 4. Industry seismic profile (located in Fig. 1) that illustrates one of many large fold structures in Gonave bay. Insets show intriguing mounds 500 m- (left) and 1200 m-deep (right) that may be cold-water corals mounds, drowned reefs, or mud volcanoes. *(depth-migrated by C. Sorlien)*

Target Name : Caribbean Seamounts

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Martha Nizinski
NOAA/NMFS/NEFSC/National Systematics Laboratory
Martha.Nizinski@noaa.gov
202-633-0671

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Caribbean Sea is a semi-enclosed basin, approximately 2,640,000 square km (Lutz and Ginsburg 2007) and includes the U.S. territories of Puerto Rico, the Virgin Islands, and the inhabited island of Navassa. Deep coral mounds and lithoherms, to depths of approximately 900 m are reported throughout region. Additionally, within the EEZ of Puerto Rico are the Virgin Islands, there are four seamounts: Grappler, Whiting, Mona, and Dos Ni'os Knoll. These seamounts are proposed as a site for exploration and investigation. Predicted bathymetric maps of three of these seamounts, available at Seamount Catalog (Earthref.org), indicate a depth range of approximately 500-2000 m. Grappler Seamount is approximately 500 m depth; Whiting Seamount is approximately 600 m at the top, 1300 m at the base; and Mona Seamount is approximately 1300 m at top, 2000 m at base. No information is available at this time for Dos Ni'os Knoll.

Brief Summary of what is known

Lutz and Ginsburg (2007) summarized the state of knowledge of deep-sea corals in the Caribbean region. These authors commented that the diversity of deep-sea corals in the region is high, but information on regional distributions as well as basic information on the biology and ecology of these habitats are lacking. Since the time of that review, little research on deep-sea corals has been conducted in this region. Recent investigations and observations in the Caribbean include, an OAR-funded expedition to the Bahamas where investigators explored deep coral habitats on the deep slopes of the Northern Bahamas, a Southeast Region deep-sea coral cruise (November 2010), funded by NOAA Deep-Sea Coral Research and Technology where investigators revisited some known coral sites (Reed 2002) in the Straits of Florida, and the report of the occurrence of deep-sea corals in the Mona Passage (Garcia-Moliner, Caribbean Fishery Management Council). Thus, there is still much to learn about the majority of known deep-sea communities in this region. Although some mapping has occurred around Grappler Seamount, other distributional, habitat, and ecological data are lacking. In fact, even the presence of deep-sea corals at these Caribbean seamounts has not been documented.

Rational for Exploration

Deep-sea coral research in the Caribbean Region is virtually nonexistent yet this region supports high diversity of deep-sea corals. Mapping with associated video will be a first step towards understanding coral distributions and habitat composition in the region.

Seamounts are known hot-spots of biodiversity and deep-sea corals can be a numerically dominant component of the invertebrate fauna associated with seamounts. Seamounts within the Caribbean region have been explored. It would be desirable to begin investigations in this region to first determine if deep-sea corals are present and then to assess the diversity, distribution, and abundance of the corals as well as the fauna associated with these corals. An extensive deepwater fishery, primarily for snapper, occurs around Puerto Rico. The association between deep-sea fishing and deep-sea coral habitat is unknown. However, damages caused by gear used in this fishery can pose significant threats to deep-sea corals. Seamounts are often target areas for a variety of commercially and recreationally important species. Given the intensive fishing activity throughout the region and the potential for fisheries to move to deeper waters, it is important to investigate these seamount habitats to determine the extent of coral growth and the diversity and abundance of species utilizing the coral habitat. Only after this information is gathered can we begin to make sound management decisions for the region. Additionally, there are many unanswered questions regarding larval dispersal and the connectivity between deep-sea coral populations. These Caribbean seamount habitats may play a vital role in supplying larvae to both the Gulf of Mexico and the southeastern United States.

Target Name : Deep Mesoamerican Reef, Caribbean Sea

Why this area may be of interest

Biology - Deep-corals and their associated fish and invertebrates
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Peter Etnoyer
NOAA Center for Coastal Environmental Health and Biomolecular Research
peter.etnoyer@noaa.gov
843-762-8645

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Mesoamerican Reef (MAR) is the Atlantic Ocean's largest coral reef, and the second largest barrier reef in the world. The reef stretches across 700 miles of the continental shelf from Honduras across Belize into Mexico, and the shelf drops abruptly to bathyal depths of 2000 meters and more. Yet, only 2 or 3 sites along the Mesoamerican Reef have ever been explored using submersibles or ROVs. Where studies were conducted, rich assemblages of hard and soft corals were found (See Fig. 1 A and B). The MAR's deep coral reefs are geographically upstream from Gulf of Mexico and Straits of Florida at the western edge of the Caribbean Current, so the MAR may be an important source of larvae to the US EEZ. This proposal seeks to lay the foundations for biological surveys of the MAR's deep coral fauna through 'telepresence enabled' mapping and exploration of the MAR's deep topography.

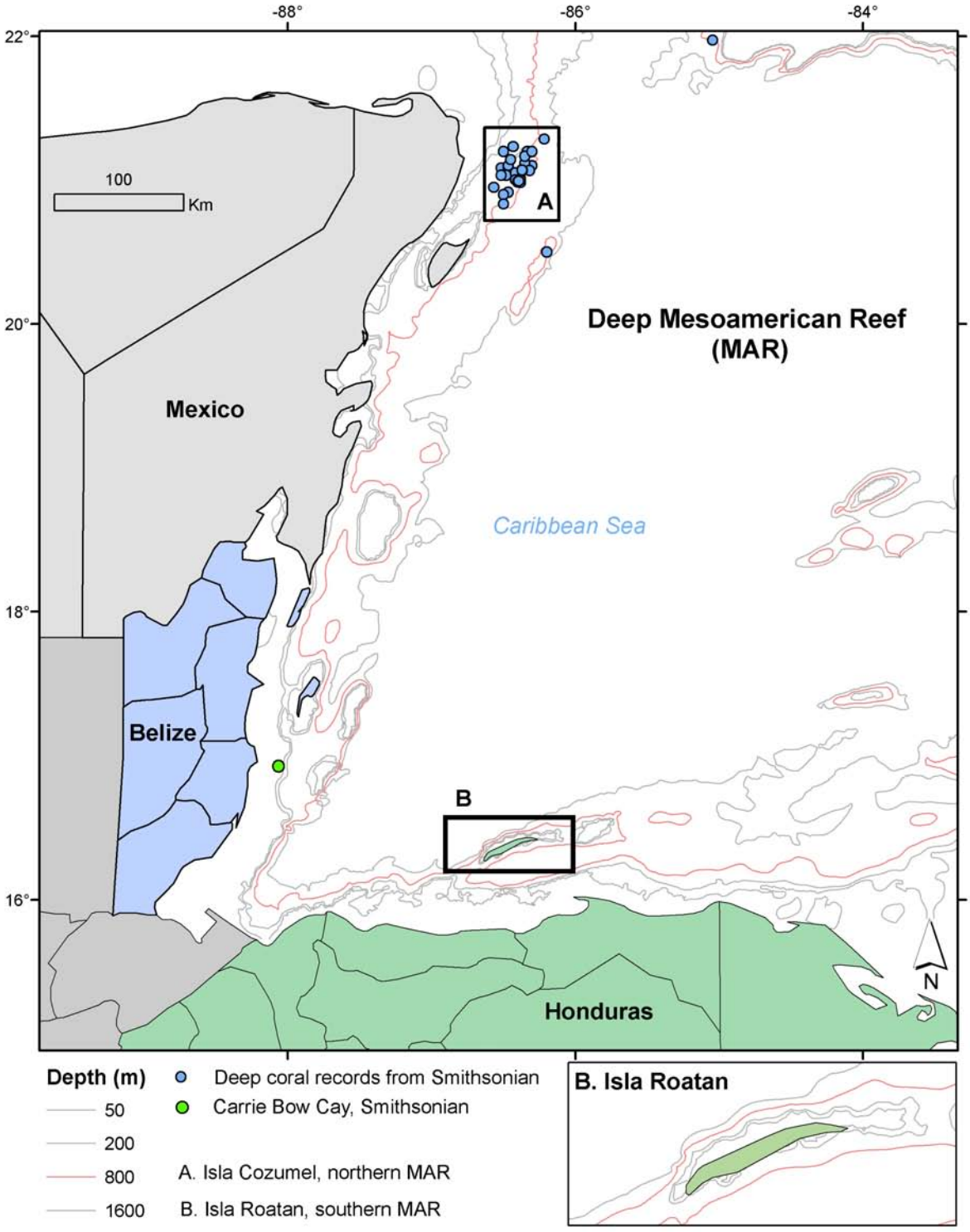
Brief Summary of what is known

Reports from Census of Marine Life indicate that Caribbean deep-sea biodiversity is poorly documented relative to other parts of the west Atlantic. However, several lines of evidence suggest deep-coral fauna are present and abundant along the MAR. Smithsonian NMNH maintains several biological specimens collected from octocoral beds in deep waters off Cozumel, Mexico. The Southern extent of the MAR was surveyed in 2010 using Idabel submersible off Roatan, Honduras. Topography off Roatan was steep basaltic rock. Three Lophelia pertusa reefs were identified in three dives to 750 meters. Gorgonians and sponges were abundant and diverse. Gorgonian biomass rivaled North American sites. Numerous invertebrates (Asteroschema brittle stars, chirostylid crabs, brisingid seastars) were associated with the corals and the epibiotic assemblage was similar to North American sites. The steep topography of the MAR off Roatan enabled continuous transects from the deep-sea (750 m) to the mesophotic zone (150 m).

Rational for Exploration

The rationale for exploration of the Mesoamerican Reef is to enhance understanding of population connectivity and exchange between the deep-water assemblages of the Gulf of Mexico and the Caribbean Sea. Underlying research questions ask 1) how does deep-coral abundance and diversity in the Caribbean Sea compare to deep-coral aggregations in the US EEZ, 2) what is the environmental niche of West Atlantic Lophelia pertusa and 2) are deep Caribbean reef populations demographically connected to the deep GoMx reef populations? Target taxa include fish, crabs, and corals. Due to the depth range, many new species are likely to be discovered. The proposal fits the operational model envisioned for the Okeanos Explorer because the work would begin with a reconnaissance phase consisting of telepresence enabled exploration, and then continue using on-the-ground technologies (ROVs, CTDs) in conjunction with federal and NGO partners. Multibeam echosounders aboard Okeanos Explorer would map targets to 100-1000 m depth. Follow-up work would use a 'high definition, high voltage' ROV from NMFS SWFSC aboard available vessels, such as the EV Nautilus, or the Schmidt Ocean Institute ships Lone Ranger and Falkor. Follow-up work would include photo and video transects and sample collections using the SWFSC ROV, plus hydrographic surveys using a CTD rosette for water chemistry, particularly aragonite saturation, in order to understand the vulnerability of these corals to climate change.

Figure 1. Map of the Mesoamerican Reef. Known locations of deep corals are illustrated by black boxes A - Isla Cozumel, Mexico and B - Isla Roatan, Honduras. The 800 meter isobath is shown in red, to illustrate the deep reef, and its proximity to shore.



Target Name : Southern Caribbean, Colombian coast.

Why this area may be of interest

Biology - Deep-sea octocoral gradient at upper slope reefs off the Colombian coast
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Juan A. Sanchez
Universidad de los Andes
juansanc@uniandes.edu.co
57-1-3394949 ext *3756

Willing to attend? ?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

On the Caribbean Colombian coast there are three specific areas (from 50-900m in depth) where deep-sea octocoral formations have been recently found. These areas correspond to San Bernardo and Rosario Islands, Santa Marta, and Guajira (see map for exact locations). In general, the Colombian continental slope falls to a maximum depth of 3500-4000m, and is characterized by a great bathymetrical and sedimentological heterogeneity (INVEMAR 2010). Along with the previous comes topographical heterogeneity with hills, valleys, seamounts and canyons (both parallel and perpendicular to the coast line), and slope drops from 2-7° in La Guajira, from 8-20° in Santa Marta, and from 9-30° near Rosario and San Bernardo islands (INVEMAR 2010).

Brief Summary of what is known

The exploration of deep-sea corals in Colombia is relatively recent. Since 1995 several expeditions have been conducted along the Caribbean Colombian coast, particularly on the continental shelf and upper slope, from 50 to 1000 m depth (INVEMAR 2010). These explorations have been done using only trawling nets along transects at different depths. Florez & Santodomingo (2010) registered 59 species of azooxanthellate scleractinians (10 families), and 56 species of Alcyonaceans (13 families). 50% of all the species collected (every phyla that came in the trawling nets) on the expeditions came from the vicinity of the three coral areas (Reyes et al 2005). This is why we can consider these areas as octocoral biodiversity hot spots.
Even though we have some information about Colombian deep-sea octocorals (from 50 – 900m in depth), we have not had the resources to explore the whole depth gradient, down to 4000m in depth.

Rational for Exploration

Given that we know very diverse shallow-water octocoral communities (<50m of depth), and also rich deep-sea octocoral communities (50-1000m of depth) we expect also very diverse octocoral communities below 1000m. The expected diversity comes from a high bathymetrical, sedimentological, and topographical heterogeneity that could generate places for upwellings, and therefore new niches for suspension feeders.

Target Name : Northeastern Antilles Mesophotic Coral Reef Ecosystems

Why this area may be of interest

Biology - Extensive development of Mesophotic Coral Ecosystem refuges
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Tyler Smith
Center for Marine and Environmental Studies, University of the Virgin Islands
tsmith@uvi.edu
1-340-693-1394

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Northeastern Antilles Arc consists of the easternmost terminus of the Greater Antilles, including the Puerto Rican Shelf, and numerous smaller islands of the Lesser Antilles chain, at the confluence of the Atlantic Ocean and Caribbean Sea. The region is home to many mesophotic depth (30-150) island shelves, shelf edges, and rises that are likely to harbor dense Mesophotic Coral Ecosystems (MCE) , but have never been explored. The oceanic environment is highly conducive to rapid reconnaissance to assess the area for the presence of MCE and provided targets for more in depth exploration.

Brief Summary of what is known

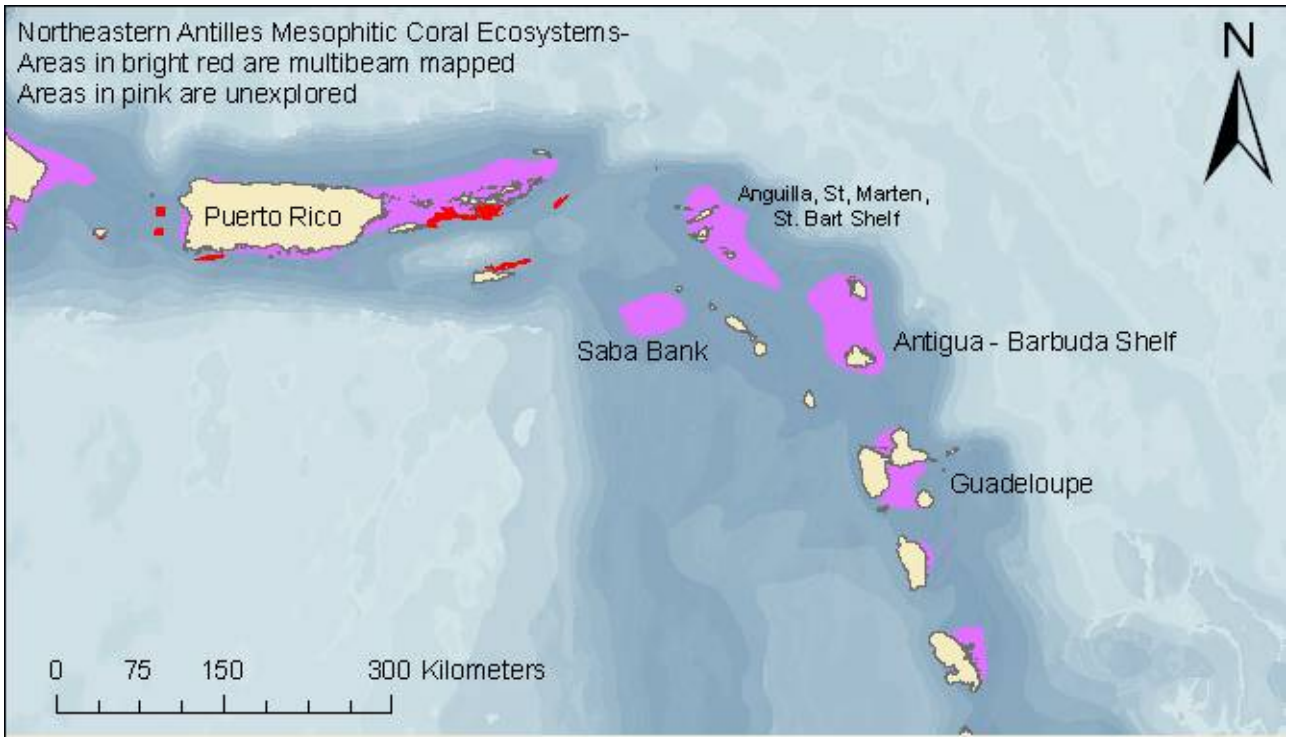
Recent explorations of the Puerto Rican Shelf and the St. Croix Shelf have revealed that some but not all shelves in mesophotic depths harbor dense MCE (i.e., those with contiguous scleractinian coral cover greater than 10% over kilometers). These include recently described and spectacularly developed bank MCE south of St. Thomas (Armstrong et al. 2006, Smith et al. 2010) as well as lettuce coral fringe ecosystems at the shelf margins (Sherman et al. 2010). From sparse information it appears that bank ecosystems (30 - 55m) are best developed on Caribbean side of islands in the lee of Atlantic Ocean ground swell and upwelling, and in association with island passages with moderately strong currents. The causes of formation of dense lettuce coral fringe habitats (60 - 100 m) are not known, though the striking variability may be related to differences in shelf margin currents, such as downwelling from the shelf at the Grammanik Bank, USVI. These reef systems possess high coral and fish species overlap with shallow water coral reefs, including endangered species such as Acroporid corals and Nassau grouper, and the corals are less affected by high thermal anomalies (e.g., coral reef bleaching) than shallow water reefs. Many shelf edge MCE are the sites of threatened large-bodied grouper and snapper spawning aggregations.

Rational for Exploration

Highly developed MCE in the Northeastern Antilles are very poorly understood but are likely to be widespread. As with recently described MCE on the Puerto Rican Shelf, there exist numerous shelves and rises can be seen in the Antilles Arc that are of the appropriate orientation and depth to contain dense MCE (e.g., the Antigua-Barbuda Shelf, the Saba Bank, The Guadeloupe Shelf, and ridges south of the Puerto Rican Shelf) but have not been adequately surveyed, largely because MCE were not acknowledged until recent times.

Though largely unexplored, MCE may be critical components of interconnected Caribbean shelf ecosystems. These reefs may serve as Essential Fish Habitat for many species that are ontogenetically connected to nearshore and shallow reefs. These reefs are likely to serve as refuges for vulnerable shallow water coral species (e.g., the Deep Reef Refugia Hypothesis; Bongaerts et al. 2010) and as reservoirs of diversity may become the highest priority for conservation. A missing link is knowledge of the distribution of these ecosystems. This knowledge would allow prediction of MCE occurrence across the Caribbean and appropriate implementation of conservation strategies.

Ocean Exploration vessels offer the best opportunity for rapid, large-scale mapping of these systems with information that can feed into higher-resolution exploration of targeted sites. Background data is available for the Puerto Rican Shelf to allow for pre-sampling calibration of sonar to quickly locate hardbottom coral reef communities, and rapidly map their distribution, with remotely operated vehicles for in-depth exploration. The vibrant and dynamic landscapes of MCE in sunlit Caribbean waters will produce dramatic outreach products (see <http://www.uvi.edu/sites/uvi/Documents/Research%20and%20Public%20Service/CMES/uvi_cmes_mesophotic_description.pdf>), and the international nature of Antilles chain offers numerous avenues for goodwill by providing information on key natural resources to small island nations. Additional benefits include a long history of shipping in the Caribbean, leading to the possibility of archeological finds, and dynamic carbonate systems atop a techtonically active area of tsunami hazards, leading to the possibility of locating new disaster risks.



Target Name : Caribbean basin deep slope

Why this area may be of interest

Biology - The deep Caribbean slope and shelf is very underexplored, but there is sufficient evidence to indicate diverse habitats and scope for new discoveries

Geology -

Chemical Oceanography -

Physical Oceanography -

Marine Archaeology -

Other - The Caribbean may be the source area for deep water fauna in the GOM and southern NW Atlantic.

Contact Information

Dr. Sandra Brooke plus collaborators SW Ross, A Baco-Taylor, J Guinnotte
Marine Conservation Institute and Oregon Institute of Marine Biology
sandra.brooke@mcbi.org
425 449 1344

Willing to attend?

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Caribbean Sea is approximately 2,640,000 km2 in area; it is a semi-enclosed basin, bounded on the west by Central America, on the south by Central and South America, on the east by the Lesser Antilles and on the north by the Greater Antilles (Puerto Rico, Hispaniola and Cuba). US waters in the Caribbean are limited to the EEZs around Puerto Rico, US Virgin Islands and an uninhabited island (Navassa Is.) between Cube and Hispaniola (Figure 1). With a few exceptions, the Caribbean Sea is deep (> 1,800 m) in depth with many areas exceeding 3,660 m. The greatest known depth (7,535 m) is in the Cayman Trench located between Cuba and Jamaica. The geology of the Caribbean basin is complex; multiple continental plates meet, creating hotspots for seismic activity and forming several deep trenches, ridges and islands. The Nicaraguan Rise bisects the basin between Central America and Jamaica; the northern edge of the rise drops rapidly into the Cayman trench, the site of the deepest known hydrothermal vent fauna. There are also shallow venting systems in the Caribbean Basin, the most well-studied of which is near Grenada in the Eastern Caribbean. The shallow banks around the islands and the steep slopes between them provide habitat for many different faunal assemblages, including deep water coral communities; however, these are very poorly explored. The southern Caribbean is dominated oceanographically by the Caribbean Current which flows through the Yucatan Channel and into the Gulf of Mexico (GOM) where it becomes the Loop Current (LC). The extent to which the LC intrudes into the GOM varies seasonally, but ultimately it flows through the Florida Keys and into the southeastern US (SEUS) Atlantic where it becomes part of the Gulf Stream. This major current links the Caribbean, GOM and North Atlantic and doubtless strongly influences faunal composition and distribution in the marine ecosystems along its path.

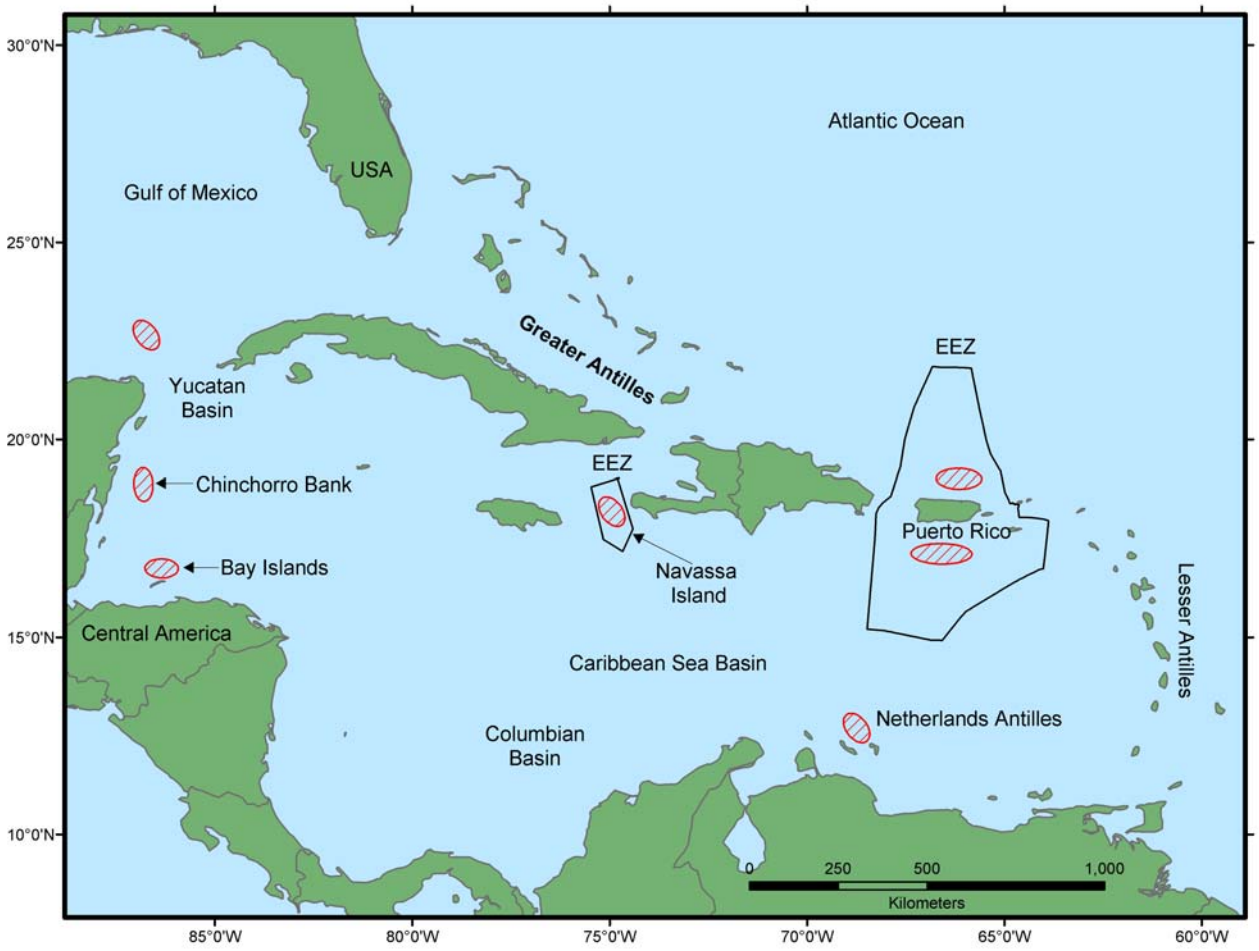
Brief Summary of what is known

The mesoamerican barrier reef that runs along the coast of Central America from the Yucatan to Honduras is the second largest in the world. While the shallow reefs in the Caribbean have been relatively well studied, information on the mesophotic realm and deeper shelf and slope is very limited by comparison. The mesophotic zone is understudied virtually everywhere as it falls between the

working depths of SCUBA and deep submergence vehicles; however, the use of shallow (<300 m) submersibles has allowed exploration of the Jamaica and Belize 'twilight zones'. Limited and largely unpublished submersible operations by NOAA and HBOI were conducted for the USVI, Puerto Rico, Cuba and the Netherlands Antilles. There are scattered records of deep water corals for the Caribbean, generally in areas of elevated current between islands, on the current-facing continental slopes or on topographic features such as seamounts. These coral records include several of the structure forming species (Lophelia pertusa, Enallopsammia profunda, large black corals and gorgonians). In general there is very little known about the biology of the deep shelf and slope regions of the Caribbean, and much of the existing information is based on scattered anecdotal or gray literature sources. Some research into hydrothermal chemosynthetic communities has been done, primarily at an active volcano near Grenada (part of the Lesser Antilles volcanic arc). Unlike the very deep Cayman trench, the active crater of this volcano is 250 m deep. Several new species have been identified from this location, but the biology is still mostly undescribed. Although there are many species common to these three areas (GOM, SEUS and Caribbean) , the connectivity pathways, if any, are still unclear. Recent genetic research on Lophelia pertusa indicates that the SEUS and GOM are distinct populations with minimal gene flow. The source of propagules for the SEUS or GOM deep coral reefs may be either, the southern Caribbean, northern Caribbean or a combination of both. Elucidating connectivity pathways is important from both scientific and management perspectives.

Rational for Exploration

A decade ago, our understanding of the deep GOM and SEUS was similar to our limited knowledge of the deep Caribbean today. There has been very little submersible or ROV work in this region, and none of these efforts have been coordinated with unified objectives. Recent exploration and research in the GOM and SEUS have revealed extensive deep water coral ecosystems, rocky slopes, soft bottom habitats and chemoautotrophic ecosystems, and documented many new species of fishes and invertebrates. This work has lead to increased awareness and enhanced protection of previously unknown ecosystems. Given the lack of deep water exploration in the Caribbean, and the diversity of deep habitats (gentle and steep shelf slopes, channels, seamounts, and tectonic plate boundaries), it is almost certain that new ecosystems will be discovered, together with new species and range extensions. A number of species, especially fishes, that are common on deep reefs in the GOM and SEUS were originally described from the Caribbean basin and were thought to be restricted to that region. It was thought that coral propagules from the GOM would be carried by the LC and seed the SEUS deep hard bottom areas; however, genetic work on the deep coral L. pertusa has shown an unexpected isolation between the GOM and SEUS. Variation in location of the LC may strongly influence genetic connectivity between the Caribbean, GOM and North Atlantic. It is possible that the source of larvae for the SEUS deep reefs is the Caribbean, rather than the GOM, but there is currently no information to support this hypothesis. Exploration of the Caribbean will increase our understanding of deep-sea ecosystems, biodiversity, and connectivity between the Caribbean and other ocean basins. This information has important implications for ecosystem management and protection both in the Caribbean and regions downstream. The mesophotic and deep Caribbean is very poorly explored, especially in regard to biology and ecology. Initial targets for research and exploration would include known areas of coral community development (Figure 1). These areas include the US waters of Puerto Rico (which has well-developed mesophotic reefs and records of deep corals) and Navassa Island, plus the steep slopes between the lesser and Netherlands Antilles and locations off the Bay Islands in Honduras and the Mexican Chinchorro Bank and Yucatan Channel. Mesophotic (~200 m) banks and mounds off Colombia (Santa Marta and San Bernardo Banks), consist of well-developed communities of azooxanthellate stony corals with abundant black corals and gorgonians; these are different types of mesophotic coral habitats from those that are extensions of the shallow hermatypic reefs. The Grenada volcanic arc would also be an interesting target for exploration, given that there are known areas of biological interest in a mostly undescribed habitat.



Potential exploration areas (red cross hatched) in the Caribbean that may represent substantial deep-sea deep-reef or other complex habitats. All of these areas below 150 m have either not been explored or very poorly explored.

Target Name : Nicaragua Rise

Why this area may be of interest

Biology - MCE:occurrence,depth range, species composition, habitats
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Robert Ginsburg
Ocean Research and Education Foundartion Inc.
rginsburg@rsmas.miami.edu
(305) 421-4875

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

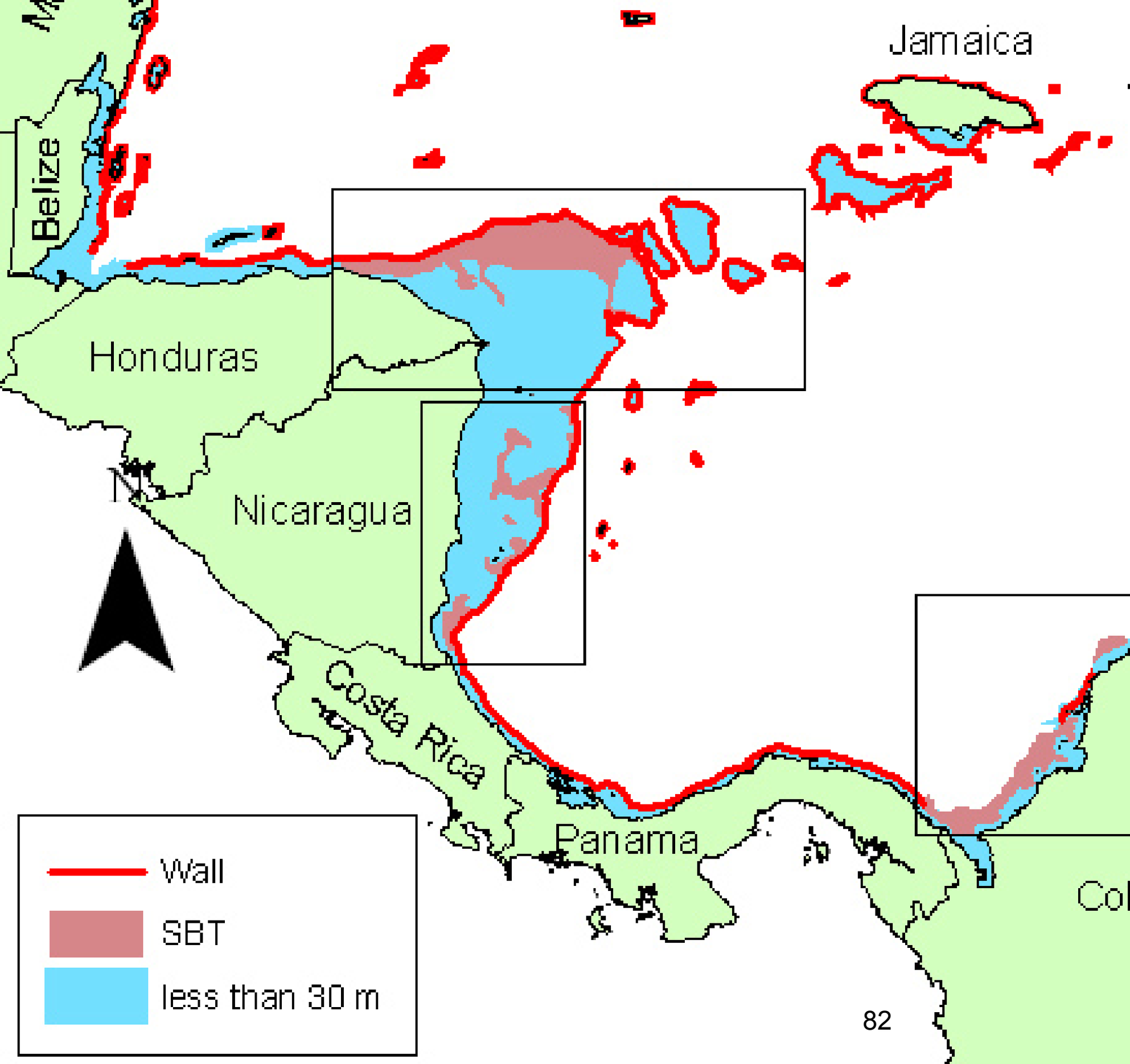
A large and poorly known carbonate platform and isolated banks with possible areas of MCEs in shelf areas and on steep platform margins. This gateway for the Western Boundary current (Gulf Stream System) is expected to have flourishing MCE communities judging what is known of a similar setting off Belize (James and Ginsburg, 1993

Brief Summary of what is known

Reconnaissance of banks documented the local presence of locally extensive green algae (Halimeda) a common reef-associated species. The area includes both a shelf area at mesophotic depths and a significant area of shelf margin (walls) facing the open
Caribbean Sea. Northward flowing tidal currents are expected amplified by the shallow shelf and isolated banks.

Rational for Exploration

Area contains two possible habitats for MCEs: shelf areas and walls (steep platform margins.) Establishing MCEs around the Caribbean Sea would extend the known occurrence and open up a large area for further exploration with the possible occurrence of new species related to the water quality of the Caribbean Sea.


Jamaica
Belize
Honduras
Nicaragua
Costa Rica
Panama
Wall
SBT
less than 30 m

Gulf of Mexico Region

Target Name : Florida Escarpment Canyon Systems

Why this area may be of interest

Biology - New hard bottom and chemosynthetic communities on the Florida Escarpment
Geology - Canyon formation, mass-transport, and connectivity from coast to abyss
Chemical Oceanography - Chemical enrichment of benthos via discharge of connate water from the Florida platform
Physical Oceanography - Gulf Stream interaction with Florida Escarpment
Marine Archaeology - Human settlements occupied during
Other - Potential for expanded oil and gas development in the Florida Offshore

Contact Information

Dr. Ian MacDonald
Florida State University, Florida Institute of Oceanography
imacdonald@fsu.edu
850-644-5498 office, 361-548-9648 mobile

Willing to attend?

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Florida Escarpment forms the western margin of the Florida Platform, a carbonate massive that includes one of the steepest continental slopes in the World Ocean. Its geology differs markedly from the sediment-dominated slope of the central and western U.S. margin of the Gulf, where loading from the N. American continent produces abundant oil and gas in a diapiric setting. The southern extent, in particular is deeply incised by a series of marine canyons that may indicate marine karsts, but certainly signal presence of conduits for unusual conductivity--biological and geological--between the shelf and the abyss. The first non-vent chemosynthetic communities were found at the base of the The margin is affected by the south-going leg of the Loop Current and may experience high current velocities. There are potentially important biogeographic settings for deepwater corals and soft corals. Human settlements may mark the outer extent of the post-glacial shoreline.

Brief Summary of what is known

Compared to the central and western Gulf, the Florida Slope and Escarpment have had relatively few exploratory or integrated scientific diving beyond scuba depths. Previous exploration of the escarpment has been geographically limited. The Paull et al. (Science, 1984, 226:965) found unexpected chemosyntheic communities at 3288m depth at the base, but the vast majority of the base is unexplored. The OE Edge of the Gulf ALVIN cruise (2000) occupied one new station at 28.037 and -86.557 and achieved a transit from 2873 to about 1500m to reveal communities unexpectedly stressed by extreme sedimentation. The upper slope features concentric bioherms and reefal complexes formed during Quarternary low-stands. Pulley Ridge comprises one such complex and features some of the deepest known examples of zooxanthellae bearing corals. The Lophelia II cruise used JASON to explore a portion of the upper slope at depths of about 500 m. New Lophelia communities were discovered, but the expedition covered a fraction of the potential habitat.

Rational for Exploration

Scientific Rationale: Exploration, with high-resolution bathymetric mapping, of one or a series of the deep canyon systems found along the southern extent of the Escarpment would quantify the connectivity of the slope biogeochemistry along cross-slope vectors. These canyon systems may differ geologic style from Eastern Atlantic canyons because they form in part due to karst processes acting on the carbonate rather than by sediment failure along a slope. Combining ADCP profiles from the surface ship with ROV-mounted ADCP observations would inform models of how canyon walls deflect and modify the near-bottom flow. An exploration strategy developed for one canyon could be replicated in two or more canyons on concurrent or subsequent expeditions to test research conclusions.

Outreach Rationale: The Florida population is strongly committed to healthy marine ecosystems, but has relatively little awareness of the biological and geological diversity of the Escarpment. This expedition could be widely shared at universities belonging to the Florida Institute of Oceanography and would excite public interest.

Management rationale: President Obama opened a large fraction of the Eastern Gulf to potential oil and gas exploration and production *prior* to the BP oil discharge. Subsequent events have underscored how lack of knowledge regarding location, variety, and function in benthic communities can complicate preparation for and response to a major oil spill.

Target Name : NE Gulf of Mexico

Why this area may be of interest

Biology - New seep and coral community types recently discovered in the area, proximity to DWH
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Erik Cordes
Temple University
ecordes@temple.edu
215-204-8876

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Northeast Gulf of Mexico, encompassing the Mississippi Canyon and DeSoto Canyon areas, remains poorly explored even after numerous efforts in this area. The DeSoto Canyon area is defined by the intersection of this isolated submarine canyon with the northen end of the Florida Escarpment. Where the near-vertical escarpment meets the seafloor, conduits for active seepage are created, while the top of the escarpment wall provides ideal habitat for deep-sea coral communities. The Missisippi Canyon region contains numerous deep-water coral and chemosynthetic communities, and is now famous as the site of the Deepwater Horizon incident. Remarkably, much of this area of the deep sea remains unexplored even after all of the efforts related to the spill.

Brief Summary of what is known

The limited number of observations of the seafloor along the northern Florida escarpment in the DeSoto Canyon area have yielded new chemosynthetic and deep-sea coral community types. These include numerous undescribed species, including Bathymodiolus mussels and bamboo corals. These have only been discovered in the last 2 years as part of the OER-BOEMRE funded Lophelia II project. Some sites in the Mississippi Canyon Area are somewhat better explored, with a series of publications in the last 10 years on the chemosynthetic and deep-water corals of the area. However, there are only a hand-full of studies of depths below 900 m due to the previous emphasis on the Johnson Sea-Link submersibles for this research.

Rational for Exploration

Although the hard grounds of the upper Louisiana Slope of the Gulf of Mexico (above about 900m) are pretty well explored, most of the over 1000 potential hard grounds in deeper waters are relatively, or completely unexplored. There have only been 2 submersible dives exploring the distinct features of the northern Florida Escarpment wall. High resolution mapping of this area followed by visual surveys would greatly increase our knowledge of this potentially isolated biogeographic province. In the Mississippi Canyon area, the Deep Water Horizon incident and our recent findings of an impacted deep-water coral community have focused efforts around the well-head. 3D seismic data held by BOEMRE suggest there are as many as 150 potential areas of hardbottom communities within about 15 miles of the DWH. Currently planned AUV mapping missions are very likely to provide detailed information on potential coral and seep communities in the vicinity of the Macondo well, but many other sites deserving exploration will not be visited. Additional exploration in this area would provide very important information to the NRDA effort. In addition to the specific areas identified here, exploration in deeper waters virtually anywhere in the Gulf of Mexico will very likely discover new species and will contribute significantly to our understanding of the biogeographic and bathymetric patterns that may define the occurrence of different types of coral and seep communities in the Gulf of Mexico.

Target Name : Yucatan Strait

Why this area may be of interest

Biology - Area of steep topography and high current flow between two deep coral biogeographic provinces

Geology -

Chemical Oceanography -

Physical Oceanography -

Marine Archaeology -

Other -

Contact Information

Dr. Erik Cordes
Temple University
ecordes@temple.edu
215-204-8876

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Yucatan Strait provides the connection between the Caribbean Sea and the Gulf of Mexico. It consists of very steep walls rising from a sill depth of approximately 2000 m. Flow through the strait is primarily to the north, but bidirectional flow has been reported in the deeper parts of the feature. This flow pattern represents the only deep-water connection of the Gulf of Mexico since the primary outlet for Gulf waters is through the relatively shallow (700 m) Florida Straits.

Brief Summary of what is known

There is a decent literature on the physical oceanography of this region, with studies of the current patterns and the development of internal waves in the strait. However, even the absolute sill depth of the strait remains a matter of some debate. There are no studies of the biology of this key area that connects two marginal basins and two different deep-water coral faunas.

Rational for Exploration

The species composition of the coral communities in the deep Yucatan Strait will contribute a significant piece to the biogeographic puzzle of the region. We are learning more and more about the deep coral communities of the Gulf of Mexico, and also the Caribbean Sea, but the knowledge of the connectivity between these two basins remains poorly understood. A key first step will be to augment our oceanographic knowledge of the strait and to conduct the first biological surveys of this area.

Target Name : Deep Midwater Visual Exploration of the Potential Prey Field of Sperm Whales in the Northern Gulf of Mexico

Why this area may be of interest

Biology - GoMex resident population of endangered sperm whales depends on deep squids
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Michael Vecchione
NMFS National Systematics Lab, National Museum of Natural History
vecchiom@si.edu
202-633-1751

Willing to attend? No

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The continental slope and rise of the northern Gulf of Mexico is an area of high human impact. In addition to petrochemical activities, the high amount of ship traffic poses risks for marine mammals. It is also the area where a population of endangered sperm whales and other deep-diving toothed whales are resident. In order to improve protection of these species, a better understanding of why they remain in this area is needed. The most likely explanation is that the availability of prey supports their year-round activities in the Gulf of Mexico.

Brief Summary of what is known

Recent deep midwater trawling conducted as components of both the the Sperm Whales Accoustic Prey Study (SWAPS) and the impact assessment of the Deepwater Horizon oil spill have demonstrated the presence of large cephalopods in the area. These cephalopods, including Architeuthis dux (the giant squid), Asperoteuthis acanthoderma (recently discovered in the Atlantic), Taningian danae, and several large histioteuthid and ommastrephid species, are probably important prey for the whales. Although net sampling demonstrates the presence of these large cephalopods, it does not provide details of depth distribution and behavior of these species which very likely are being targeted by feeding whales.

Rational for Exploration

I suggest that OE expeditions include midwater ROV dives at depths of 600-1000 m (the feeding depth of sperm whales) at locations both where whales are seen and similar areas where whales are not seen.

Target Name : Northern Gulf of Mexico Potential Shipwreck Exploration Project

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology - Explorations of up to five potential deepwater shipwreck sites
Other -

Contact Information

Mr. Daniel Warren
C & C Technologies working in conjunction with the PAST Foundation, BOEMRE, and USGS
djw@cctechnol.com
713-468-1536

Willing to attend?

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The exploration sites are located in the Northern Gulf of Mexico Region (See Attachment Sheet). They lie within the Viosca Knoll and Mississippi Canyon Lease Areas off Louisiana's southeastern coast (Figure 1). Geologically, this area is associated with the Upper Mississippi Fan. Regional seafloor topography is generally flat to mildly undulating and is typically composed of sandy silts. Water depths at the exploration locations range from approximately 912 to 2,261 feet.
The sites are near historic shipping routes that have been used for over 300 years to explore and traverse the Gulf of Mexico. Several historic shipwrecks have been discovered and explored nearby, including the Viosca Knoll (circa 19th cent.), Mardi Gras (circa 1814), Anona (circa 1904), and Mica (circa 19th. cent.) wrecks. These known significant maritime heritage sites near the current exploration areas illustrate the high potential for discoveries in this region of the Northern Gulf of Mexico.

Brief Summary of what is known

Data on each exploration site is limited. It has been derived mainly from oil and gas exploration surveys and an October 2009 AUV multibeam survey carried out from the NOAA R/V Nancy Foster. Site designations are based on the 2009 Nancy Foster Survey.
PD048(Image 1) is a 238 x 29 x 16 foot target in approximately 1,590 feet of water. Its narrow elongated shape suggests a vessel of unknown type, date, and origin.
PD049(Image 2) is a 80 x 30 foot target in approximately 2,261 feet of water. It unique oval shape and the apparent area of hard return indicated in the multibeam data suggest a vessel of unknown type, date, and origin.
PD050 (Image 3) is a 130 x 30 x 4 foot target in approximately 912 feet of water. Its overall shape is similar to that of documented historic shipwrecks and likely represents a vessel of unknown type, date, and origin.
PD051(Image 4) is a 182 x 35 x 25 foot shipwreck in approximately 1,306 feet of water. Data indicates this is the remnants of a wooden sailing vessel of unknown date and origin with substantial intact hull remains.

PD052 (Image 5) is a 81 x 36 x 5 target in approximately 939 feet of water. Data is inconclusive on this target. It has characteristics similar to known wooden shipwrecks that have broken up, but could also represent a natural outcrop. Further explorations are needed to determine the origin of this target.

Rational for Exploration

Deepwater shipwrecks represent both the physical remnants of our cultural past and unique micro-ecosystems. To more fully understand them research must be multi-disciplinary, incorporating both archaeological and environmental studies. Recent research from the 2004 DeepWrecks and the 2008 Lophelia II Rigs, Reefs, and Wrecks projects has provided the first detailed glimpse of the complex dynamics of deepwater shipwrecks in the Gulf of Mexico. As research moves forward a broader data sample is needed to better understand the processes at work on these sites. The five proposed site explorations are important to expanding our wreck site data. They are the first step towards more detailed studies of these wrecks. Using visual data from these investigations scientists will make initial archaeological assessments and begin preliminary documentation of biological communities on the sites. The resulting information will be used to plan and prioritize future detailed investigations. It may also be integrated in a limited manner with current data from ongoing studies to provide a more diverse sampling from a broader range of water depths. Finally, scientists will use this exploration data to develop detailed research designs to guide future research in the quest to get a clearer perspective on the cultural aspects of deepwater shipwreck sites as well as a better understanding of the processes related to their formation, evolution, and function as marine ecosystems."

Atlantic Basin Workshop Attachment Sheet: Northern Gulf of Mexico Potential Shipwreck Exploration Project

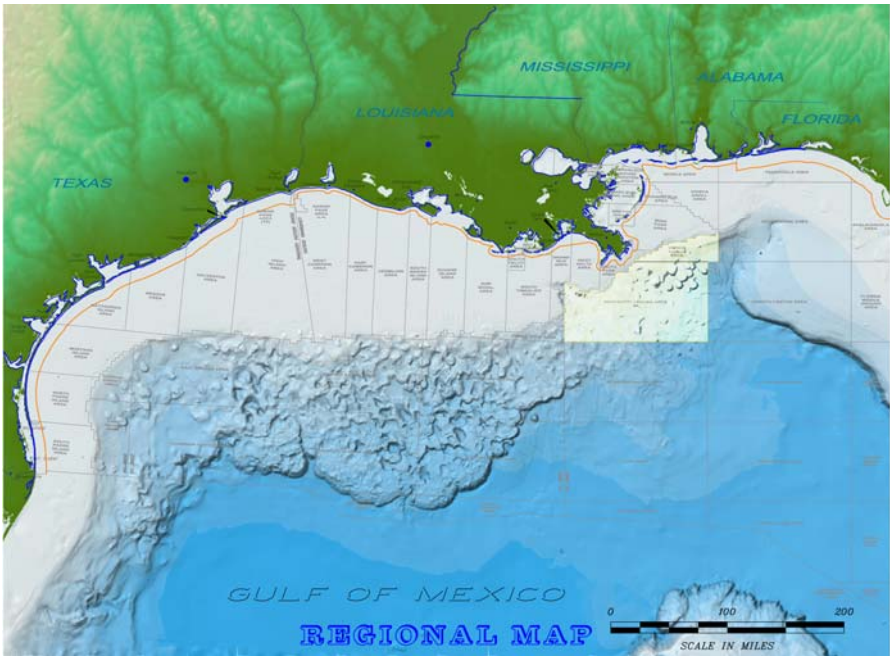


Figure 1. Regional map highlighting the Viosca Knoll and Mississippi Canyon Block Areas.

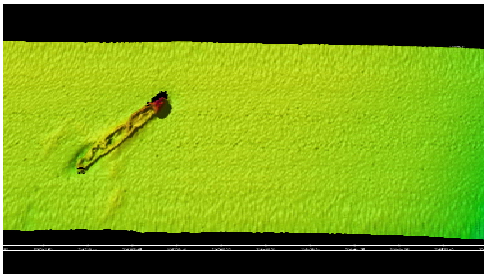


Image 1. Site PD048-multibeam data

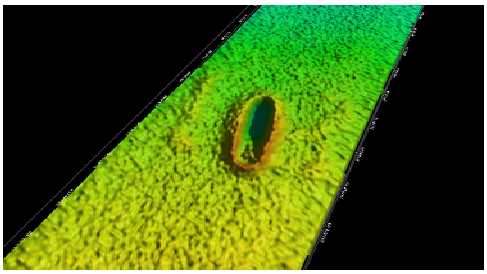


Image 2. Site PD049-multibeam data

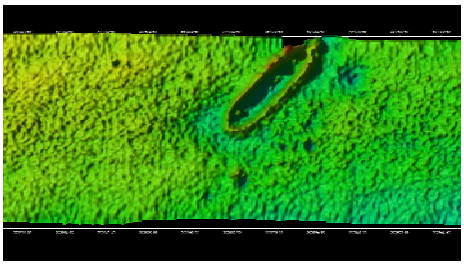


Image 3. Site PD050-multibeam data

Image 4. Site PD051-sidescan sonar data

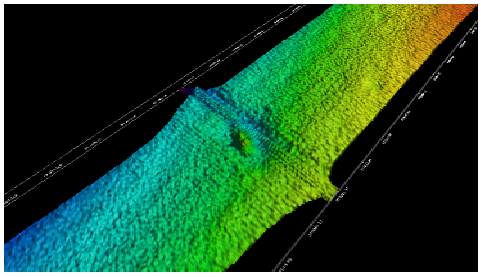


Image 5. Site PD052-multibeam data

Target Name : Gulf of Mexico slump and creep area on slope (multiple options)

Why this area may be of interest

Biology - Spatial Variation in Soft Bottom
Geology - Spatial Variation in Sediment Mixed Layer
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Robert Carney
Louisiana State University
rcarne1@lsu.edu
225-578-6511

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Mid-Slope Site - 2000m in Mississippi Canyon region of Gulf of Mexico. High resolution bathymetric surveys have shown that a seemingly homogenous mud bottom is marked by a slump scar and linear rips in the sediment surface. These rips are up to 50m long and 5m deep. Industry-supported rov surveys indicated that both the slump scar and rips are faunistically distinct.

Brief Summary of what is known

Previous industry rov surveys have been run but followed an observation design that provided operational information. Ecological data lacked the necessary spatial coverage, but was especially interesting. Normal deep-sea megafauna were common upslope of the slump scar but apparently depauperate down slope. The "rips" were completely soft sediment or contained a limited amount of authigentic carbonate with seep fauna development. None of the usual geological indicators (surficial and within the slope) were observed.

Rational for Exploration

The full ocean must be explored, not just the most photogenic parts. It is now very well established that the biology of the mud bottom is spatially heterogenous. Mud-bottom sponge banks, areas of extensive large bioturbation, color shifts, and aggregated faunal are among the most obvious manifestations of the variability of deep mud. Effective exploration using telepresence capabilities requires new tools and new modes of extracting information from images. The scared and torn section of the Mississippi Canyon region affords an opportunity to explore and develop mor effective exploration methods.

The proposed site is in the proximity of large seeps and coral systems that can be studied with the usual imaging approaches. Thus the site allows for the effective use of vessel time.

Telepresence Image Survey of Slump-Scared Deep Mud Bottom

R.S. Carney, LSU
S.J. Bentley, LSU

Proposed: Carry out a slow video and still imaging survey of a scared and torn mud bottom to document faunal and sediment spatial variation. A Gulf of Mexico site with high res bathymetry and preliminary rov survey will be targeted.

Background: It is well established that deep mud bottoms have substantial spatial variation when image-derived data is statistically analyzed. Unfortunately, the primary sampling tools of deep ecology are corers and trawls incapable of capturing this variation. To effectively explore the vast deep mud bottom, better approaches to image surveying must be developed. The complex topography of the deep Gulf of Mexico affords several obvious survey targets. The site proposed shows indication of slope instability and active creep. Preliminary surveys indicate a related variation in the normal fauna and an unexpected transition to small seep systems (Figures 1 and 2).

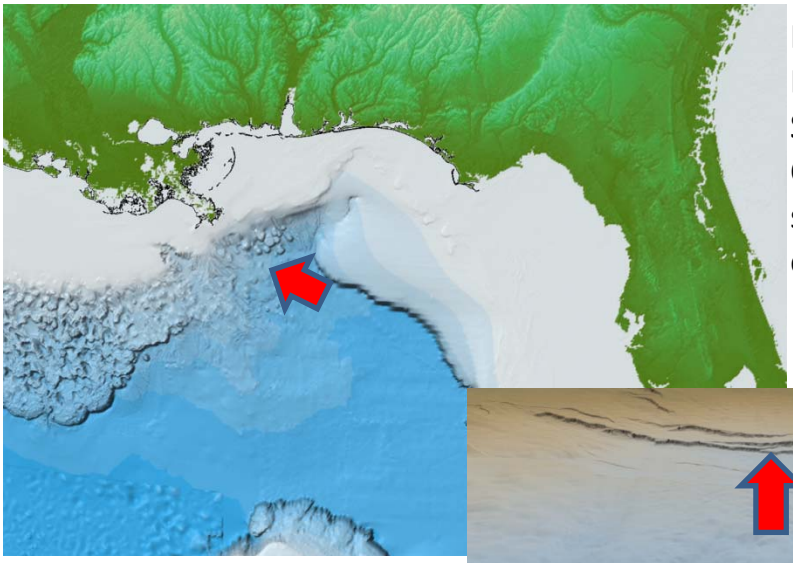


Figure 1. Location of targeted Bottom.
Survey area is near Mississippi Canyon. It is not the recent spill site. Similar sites can be found elsewhere in the Gulf.

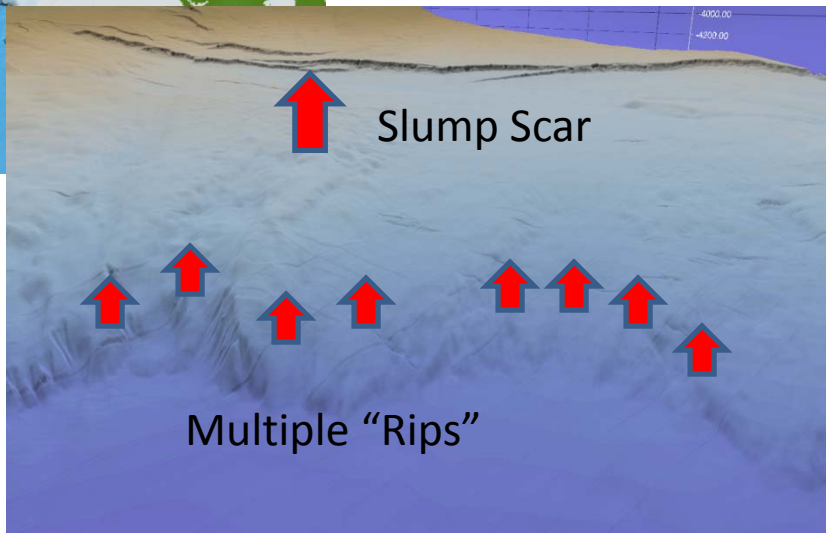


Figure 2. Target Features
Slump scar has 2-5m relief for > 5km. Small rips can be up to 50m long and contain normal fauna and/or small seeps

Target Name : 120m to 75m isobaths region on the slope of the Inner Continental Shelf from west side of Apalachicola peninsula southeast beyond Steamboat Lumps

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology - X
Other -

Contact Information

Dr. C. Andrew Hemmings
Mercyhurst Archaeological Institute, Mercyhurst College
chemmings@mercyhurst.edu
620-757-4111

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The steep slope of the ICS was covered by water over a period of roughly 6,000 years (~18,000 to 12,000 RCYBP). During this period less than 20km of land was submerged along the west coast of Florida. By 12,000 RCYBP people are found scattered across the entire New World, but in very low numbers. Several near shore, elevated, or cliffside, locations between the 120 and 70m isobaths would have remained ideal habitation sites for potentially thousands of years at the very early end of the human colonization of this hemisphere. This stretch of Florida's Pleistocene coast has exposed rock, is likely to have contained stone usable for tool manufacture, and would have held the edge of the surficial freshwater aquifer, on a long border between coastal marine and terrestrial resources. All of which would have been strong draws to people making a living when this area was still dry land.

Brief Summary of what is known

Several smaller scale sonar mapping projects have covered parts of this long area but none have targeted landscape features that would have been attractive to early human inhabitants, and archaeologists attempting to locate submerged sites. Research along this area to date has tended to focus on topographic features important to marine organism communities and general hydrological surveys. Video imagery of this area available to archaeologists is severely limited. For archaeologists most of this inundated coastal area is firmly terra incognita.

Rational for Exploration

Because the top of the ICS (roughly 80-70m) remained nearshore for thousands of years, and then was quickly inundated after 12,000 RCYBP, there is a very good chance that early people congregated along this ridge top and that their sites were covered by water and sand quickly enough to expect preservation of these locations. Further, as part of our work (James Adovasio and Andy Hemmings) we have encountered numerous rumors of caves in the Florida Middle Grounds and further offshore. As the porous limestone is exposed at numerous locations along the slope we would hope to potentially find preserved karst solution features in this area, whether they are actually caves or sinkholes. Employing the high resolution multibeam system and AUV video camera's of the Okeanos Explorer for this application would improve the quality of data, areal coverage, and available imagery, for the area in general and holds the potential to greatly improve our understanding of the lifeways of early colonists of the New World.

Target Name : Reefs and Banks of the Northwestern Gulf of Mexico

Why this area may be of interest

Biology - X
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Ms. Emma Hickerson
Flower Garden Banks NMS
emma.hickerson@noaa.gov
979-324-7337 (cell)

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.-	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Dozens of reefs and banks are scattered across the outer continental shelf of the Northwestern Gulf of Mexico harboring diverse assemblages of deep coral reefs, black corals, octocorals, sponges, algae, deep reef fish, and invertebrates, as well as geologically significant basalt spires and brine seeps. Despite focused research over the last decade, much of the region remains unmapped and/or unexplored. This area is one of the most active oil and gas fields in the world, and has been subjected to one of the worst oil spill events on record. It is expected that the NW Gulf habitats were not and will not be impacted from the Deepwater Horizon blowout, however baseline information is critical for any future response effort. Information gained from future exploration will directly enhance management decisions by regulatory agencies including BOEMRE, NOAA Fisheries, and Office of National Marine Sanctuaries.

Brief Summary of what is known

In 2002 the Office of Ocean Exploration and Minerals Management Service (now BOEMRE) co-funded a multibeam mapping project with USGS to collect approximately 2000 km2 of high resolution multibeam data covering 12 topographic features in the northwestern Gulf of Mexico. This data provided the base data layer for planning and implementation of 14 dedicated ROV cruises. Subsequent mapping efforts have revealed high physical connections between banks, referred to as "habitat highways". Regional biological catalogs and updated biological habitat characterization schemes have been developed from the combination of the multibeam and ROV cruises. The level of information gathered has led to the ability of the FGBNMS to propose sanctuary boundary expansion to nine (9) additional reefs and banks in the region through the Management Plan Review process. A GIS based mapping tool displaying layers of bathymetry, surveys, biology, management zones, and oil and gas infrastructure (as examples) is available for public exploration at:
http://www.ncddc.noaa.gov/website/google_maps/FGB/mapsFGB.htm

Rational for Exploration

The reefs and banks of the Northwestern Gulf of Mexico remain an area awaiting discoveries. Only a handful of people have had the benefit of viewing first hand the beauty of the deeper water environments in this area during ROV surveys and a few submersible excursions. The FGBNMS has long been interested in sharing this region with the public through a documentary, or via telepresence but have not had the resources to do so. The extent of the unexplored areas is vast. There and many locations that have the benefit of acquisition of multibeam already, and are awaiting groundtruthing, but there are also target locations that have not been surveyed, and have not been visited ever, or at least since brief visits by Texas A&M University and Bureau of Land Management research in the 1980's. The information gained will be invaluable for future management decisions by multiple regulatory agencies, as well as visually exciting for the purposes of live transmissions. The public could be engaged on different levels - from viewing for education and outreach to data collection through projects such as Zooniverse (see www.zooniverse.org). The FGBNMS maintains the GIS based mapping tool with NOAA's NCDDC - a portal through which imagery, dive tracks, and discoveries can be presented.

Target Name : Deep Sea Coral Reefs: Western Atlantic and Gulf of Mexico

Why this area may be of interest

Biology -
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Mr. John Reed
Harbor Branch Oceanographic Institute, Florida Atlantic University
jreed12@hboi.fau.edu
772-242-2205

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Deep sea coral reefs, dominated by scleractinian coral (Lophelia pertusa, Enallopsammia profunda, Madrepora oculata), black coral, gorgonians and sponges.
1) Eastern Gulf of Mexico: West Florida shelf, from Pensacola to Tortugas, 400-500 m depth.
2) Southern Straits of Florida: Agassiz and Tortugas Valleys, Pourtales Escarpment, 400-1000+m.
3) Eastern Blake Plateau: Stetson Bank region to Blake Escarpment, 800-1500+m.

Brief Summary of what is known

Site 1: In the GOM, deep sea Lophelia reefs are well known primarily at Viosca Knolls. Little is known off the west Florida shelf. With NOAA OE funding in 2003, Reed et al. (2006) documented with ROV dives newly discovered Lophelia reefs 100 miles west of Naples at 500 m depth. More reefs were discovered during our NOAA CIOERT cruise last summer in response to the BP oil spill. Recent multibeam maps funded by NOAA were made along this ridge which shows the potential of hundreds of undocumented deep sea reefs over a 100 miles along the south west Florida shelf.
Site 2: Reed et al. (2005, 2006, 2011) described deep coral habitat within the Straits of Florida but little is known of the Agassiz and Tortugas Valleys south of Tortugas, and the Pourtales Escarpment to depths >1000 m and out to the U.S.-Cuba EEZ. Reed et al. described extensive regions of coral habitat on top of the Pourtales Terrace, and Grasmueck et al. described deep coral mounds on the Bahamas side of the Straits.
Site 3: Since Stetson et al. first described deep sea coral mounds on the eastern Blake Plateau off South Carolina, Reed et al. (2006) were the first to conduct submersible dives documenting these reefs with NOAA OE funding in 2002. The potential for discovery of many more deep sea reefs in this area is great. Even less is known in deeper water of the Blake Escarpment which should also be mapped for potential hard bottom and seep targets.
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Rational for Exploration

Deep sea coral reef and hard-bottom ecosystems support vast amounts of the ocean's biodiversity and exhibit exceptional variation in relative forms, functions, origins, and locations. Given the magnitude, location, and depth of the Deepwater Horizon oil spill and potential for drilling off Cuba, a major concern for offshore impacts in U.S. waters is the impact on deep sea coral reefs found throughout the Gulf of Mexico and along the southeastern U.S. continental shelf. Impacts on these reefs and hard-bottom communities may severely reduce ecological functions, ecosystem services, and quantifiable economic value. These impacts are likely to vary considerably in these understudied, poorly documented coral habitats. These data will be of value to the South Atlantic and Gulf of Mexico Fishery Management Councils for management decisions on these key species and habitat. Ultimately the primary benefits are critical data that characterize the resources, habitat and ecosystem functions, ecosystem services, and, when applicable, the impact of management actions on these resources.

Target Name : Benthic and Demersal Megafauna of the Potential Extended US Seabed under the UN Convention on the Law of the Sea.

Why this area may be of interest

Biology - Jurisdiction over benthic megafauna would be included under UNCLOS
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Michael Vecchione
NMFS National Systematics Lab, National Museum of Natural History
vecchiom@si.edu
202-633-1751

Willing to attend? No

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

In many places along the US East Coast and in the Gulf of Mexico, the "extended continental shelf" (ECS), as defined under Article 76 of the UN Convention on the Law of the Sea (UNCLOS), extends substantially beyond the 200 nm US Extended Economic Zone (EEZ, see Figure). Under Article 77 of UNCLOS, "sedentary" living resources of the seabed in these areas include benthic infauna (e.g., borrowing clams) as well as mobile (crabs and echinoderms) and attached epifauna (corals) that when adult remain in contact with the bottom at all times. Jurisdiction over such resources is assigned by UNCLOS to the coastal state claiming the ESC. Although jurisdiction over demersal megafauna (e.g., bottom-associated fishes and cephalopods) is not assigned under UNCLOS, such species often are dependent on the distribution of UNCLOS "sedentary" resources. Exploration by visual survey, as suggested below, can assess demersal fauna at the same time as both attached and mobile epibenthic "sedentary" resources.

Brief Summary of what is known

The benthic infauna has been studied fairly intensively in some of these areas (e.g., Gay Head to Bermuda transect and other areas as summarized in the ASCAR report) and similar areas nearby (HEBBLE), with more limited associated studies of epibenthic megafauna. However, recent experiences of the deepwater projects of the Census of Marine Life (e.g., MAR-ECO) show that exploration using a variety of modern methods can greatly expand both inventory and understanding of deep-sea biodiversity.

Rational for Exploration

I suggest that OE expeditions include ROV line-transect visual surveys at locations both in the ECS and, for comparison, inside the nearby EEZ. The locations should be determined by depth-stratified random methods. Selection of target areas in the ECS could be coordinated with other OE missions. Budget permitting, such in-situ visual methods off the northeastern US could be coordinated with deep bottom trawling by a NOAA Fisheries Survey Ship, such as the Bigelow, to produce a more complete picture of the large animals of the deep seabed.

Fig. Approximate areas of "extended continental shelf" under UNCLOS for the US in the western North Atlantic and Gulf of Mexico, from the Center for Coastal Ocean Mapping, Univ. of New Hampshire. For details see http://www.ccom.unh.edu/unclos

Target Name : Artificial Seep Deployments on Upper Slope and Slope Base Gulf of Mexico & US Atlantic Coast

Why this area may be of interest

Biology - Experimental Seep Colonization
Geology -
Chemical Oceanography -
Physical Oceanography -
Marine Archaeology -
Other -

Contact Information

Dr. Robert Carney
Louisiana State University
rcarne1@lsu.edu
225-578-6511

Willing to attend? Yes

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

Upper-Slope Site - 500 - 750m in long-studied Bush Hill and Brine Pool NR1 area (Green Canyon 184/5 and 233). Deployments follow a spatial ANOVA with proximity to seep being a major factor. Positions well established during prior Johnson SeaLink dives.

Slope-Base Sites - Six locations, 2000-3000m depth between WHOI and Galveston. All on mud bottom. Positions known from surface deployment location. West Florida Escarpment site confirmed by ALVIN dive

Brief Summary of what is known

The devices are working as intended, but colonization is slow and needs long-term monitoring.

Upper-slope site in Gulf of Mexico was partially sampled in 2006 after only 3 years in place. For the recovered devices sulfide, sulfate, oxygen, and microbial activity was profiled. Fauna was identified. All collected devices were sulfidic. Seep colonization was limited and consisted of lucinid clams and small vestimetiferan tubeworms. Twenty four devices were left for long-term monitoring. Image examination after 6 years at a single site showed extensive colonization by tubeworms in 2 out of 3 devices.

Rational for Exploration

NOAA-OE originally supported development of sulfide biogenerators (artificial seeps) because it is a low-cost technology that opens the door to experimental studies of seep community distribution. Deployments can be made from ships of opportunity long before more expensive assets like rov's and hov's carry out detailed exploration. Such pre-placed instrumentation can greatly increase the information yield of exploration.

Our trial studies have shown the value of artificial seeps, but found colonization rates to be slow. Telepresence offers the ability to monitor colonization. Direct sampling can then be planned for future years when warrented.

Visual Status Check of Colonization of Artificial Seep Systems

R.S. Carney, LSU
W. Ziebis, USC

Proposed: R/V Okeanos Explorer visit sulfide-generating deployments in place since 2001 to 2003 to determine extent and nature of seep-like colonization via imaging and telepresence.

Background: In 1999 it was found that a simple substrate of pressed alfalfa provided sufficient sulfide during in-situ decomposition to attract and support cold-seep tubewoms. With NOAA-OE support trial deployments were begun in 2001. Extensive deployment on the Gulf of Mexico upper slope was carried out in 2003 (Figure 1) as well as slope-base deployments in the Gulf and NW Atlantic (Figure 2). The construction of the devices allows simple visualization to provide critical information about colonization and the status of the substrate. Deployments are located in regions where other operations may be scheduled (Figure 3).

Figure 1. Image inspection at 6 years of 3-device cluster in upper-slope series showing well defined sulfide layer (black), remaining substrate (brown), and tubeworm aggregations in 2 devices. 24 similar devices remain in situ for monitoring. 2009 by C.M. Young.

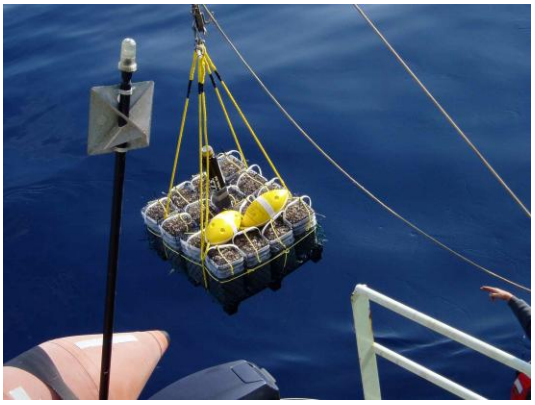

Figure 2. 2003 surface deployment of 16 devices at the slope base. Vertically mounted transponder allowed tracking during descent. Yellow syntactic foam floats provide visual and acoustic targets. Six deployments (96 devices) were made in 2003 and have not been re-examined since.

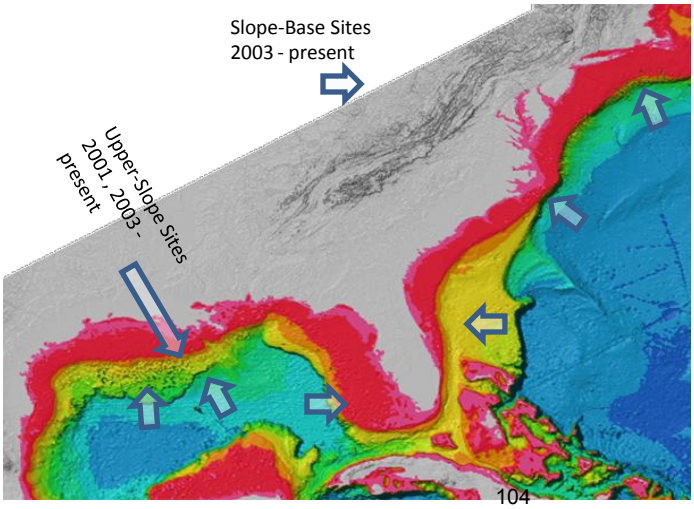

Figure 3. Location of Deployments. Upper-slope Gulf of Mexico within a 5km radius 500 – 750m according to a spatial ANOVA design. Slope-base sites 2000-3000m between WHOI and Galveston.

Target Name : The Straits of Florida - Key West, USA to Havana, Cuba

Why this area may be of interest

Biology - pelagic species, larval transport
Geology -
Chemical Oceanography - pollutants, toxins
Physical Oceanography - climate
Marine Archaeology -
Other - Undersea communications, cabled obseervatory technology,politics/sociology

Contact Information

Mr. Doug Wilson
NOAA (NMFS)
doug.wilson@noaa.gov
410-267-5648

Willing to attend?

General Region of Field Operations

Gulf of Mexico-**Yes**	West. North Atlan.- **Yes**	North.Mid-Atlan.-	East. North Atlan.-
Caribbean Sea-**Yes**	West. South Atlan.-	South.Mid-Atlan.-	East. South Atlan.-

Brief Overview of Area

The Straits of Florida in this region is the link and choke point between the Caribbean/Gulf of Mexico and the North Atlantic Ocean. It is the pathway for water masses and all things current-driven - oceanic salt and heat, pelagic species, larvae, pollutants. The Straits here are bounded on the north by the coral reefs and Marine Sanctuaries of the Florida Keys, on the south by the mangroves and beaches of Cuba. From the west 30 millon m3/sec flow either directly from the Caribbean Sea through the Yucatan Channel OR having passed by the Mississippi River discharge and oil wells of the northern Gulf of Mexico in the Loop Current. Currents flowing eastward in excess of three knots flow rapidly past Florida and the Bahamas directly into the Gulf Stream and the North Atlantic. The northern shelf is relatively wide, with multiple coral reef lines along the shelf; depths elsewhere are 500 - 1500 m, exceeding 1800 m near the south shore before rising rapidly to the coast of Cuba.

Brief Summary of what is known

This highway of the North Atlantic is poorly explored, but through it pass large pelagic fish, mammals, and turtles, as well as their juvenile and larval stages. Because of international clearance issues, there have been very few opportunities to collect data in Cuban waters. The SoF provides the interconnectivity between the equatorial Atlantic and the Caribbean (and its extreme shallow water biodiversity) and the North Atlantic - often after a trip around the (difficult to forecast) Gulf of Mexico Loop current. We do know that deep (<2000 m) water enters the SF, but only the upper 800 m exits past Florida and the Bahamas. We know that shifts in the North Atlantic circulation will show themselves as changes in the amount, sources, and structure of the waters. Shallow reefs on the north side are affected by nutrient upwellings from the deep waters. Deep water corals have been found but remain poorly mapped and identified, along with benthic utilizing the deep coral habitat. All depths are potentially at risk due to deep water petroleum drilling in the Gulf of Mexico and north coast of Cuba.

Rational for Exploration

- A great deal of Straits are unexplored, especially the deep waters and bottom, and the southern side.
- Potential issues to address include climate (the surface waters of the North Atlantic Thermohaline Circulation, source of the Gulf Stream, pass through the Straits); source waters from the DWH spill, at 1500m, could be concentrated in the deep waters of the Straits; oil exploration is being conducted along the Cuban coast for future drilling; an Ocean Tracking Network line to track tagged species is planned, but may require testing of new technologies in this demanding deep, high-current environment. There are plans in place to lay a new fiber optic telecommunications cable between Key West and Havana; operators have offered to install science nodes along the bottom. There are corals ranging from coastal reefs to unexplored deep coral in mid-channel.
- New technologies - gliders, auv/rovs, surface wave gliders, bottom acoustics, can be deployed and tested in a high current environment.
- Perhaps the most significant unknown wanting further exploration arises from the 50 years of missing data due to political differences between the US and Cuba. This is an opportunity to share the scientific exploration with our neighbors to the south - I believe (no guarantees), based on my previous experiences working with Cuban oceanographers in Cuban waters , that we could arrange a cooperative cruise. This would also generate considerable public (and media) interest in following the explorations in real-time.
- I envision an exploration across the Straits of Florida from Key West to Havana, following the route of the communications cable - through the shallow reefs, over the shelf, tagging and real-time tracking pelagic fauna and collecting zooplankton, looking for DWH or other pollutants in the deep cul-de-sac, mapping benthic habitat and identifying deep water corals, until the path surfaces along the steep wall along the northern coast of Cuba.